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Natural Resource Stewardship and Science

Channel Islands National Park Kelp Forest Monitoring Program

Annual Report 2013

Natural Resource Report NPS/MEDN/NRR—2020/2146



ON THE COVER
Southern shore of Santa Rosa Island
Photograph by Jaime McClain, Channel Islands National Park

Channel Islands National Park Kelp Forest Monitoring Program

Annual Report 2013

Natural Resource Report NPS/MEDN/NRR—2020/2146

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Executive Summary

Channel Islands National Park (CHIS) has conducted long-term ecological monitoring of the kelp forests around San Miguel, Santa Rosa, Santa Cruz, Anacapa and Santa Barbara islands since 1982. The original permanent transects were established at 16 sites between 1981 and 1986 with the first sampling beginning in 1982. An additional site, Miracle Mile, was established at San Miguel Island in 2001 by a commercial fisherman with assistance from the park. Miracle Mile was partially monitored from 2002–2004, and then fully monitored (using all KFM protocols) since 2005. In 2005, 16 additional permanent sites were established to collect baseline data from inside and adjacent to four marine reserves that were established in 2003. Sampling results from all 33 sites mentioned above are included in this report. Funding for the Kelp Forest Monitoring Program (KFM) in 2013 was provided by the National Park Service (NPS).

The 2013 monitoring efforts utilized 45 days of vessel time to conduct 938 dives for a total of 863 hours of dive time. Population dynamics of 71 "indicator species" (consisting of taxa or categories of algae, fish, and invertebrates) were measured at the 33 permanent sites. In addition, population dynamics were measured for all additional species of fish observed at the sites during the roving diver fish count and fish size frequency protocols. Survey techniques follow the CHIS Kelp Forest Monitoring Protocol Handbooks (Davis et al. 1997; Kushner and Sprague, in progress). The techniques utilize SCUBA and surface-supplied-air to conduct the following monitoring protocols: 1 m^2 quadrats, 5 m^2 quadrats, band transects, random point contacts, fish transects, roving diver fish counts, video transects, size frequency measurements, and artificial recruitment modules. Hourly temperature data were collected using remote temperature loggers at 32 sites, the exception being Miracle Mile where there is no temperature logger installed. This annual report contains a brief description of each site including any notable observations or anomalies, a summary of methods used, and monitoring results for 2013.

All of the data collected during 2013 can be found in the appendices and in an Excel workbook on IRMA. The order of appendices presented in this report has been modified from previous years. Roving diver fish count (RDFC), fish size frequency, natural habitat size frequency, and Artificial Recruitment Module (ARM) size frequency data are now stored on IRMA at https://irma.nps.gov/DataStore/Reference/2259603. Several changes were made to Appendices E – I, the appendices presenting density and percent cover data. Previously, density and percent cover data tables only included the current year's data. Now, density and percent cover data are presented in graphical format and includes all years of available monitoring data. Roving diver fish count (RDFC), fish size frequency, natural habitat size frequency, Artificial Recruitment Module (ARM) size frequency remain unchanged and present data from the current year only. The temperature data graphs in Appendix L include the same graphs that were used in past reports but include an additional violin plots section that compares monthly means from the current year to past years. Additionally, the layout of the discussion section was reordered by species instead of by site.

The status of kelp forests was notably different between the five Park Islands. This is a result of a combination of factors including but not limited to, oceanography, biogeography and associated

differences in species abundance and composition, as well as sport and commercial fishing pressure. All 33 permanent sites were established in areas that had or were historically known to have had kelp forests in the past.

In 2013, 13 of the 33 sites monitored were characterized as kelp forests. In addition, three sites were in a state of transition seemingly towards kelp forests. The remaining 17 sites were mostly dominated by echinoderms consisting of sea urchins and spiny brittle stars, *Ophiothrix spiculata*. Overall, the total number of sites characterized by kelp forests or dominated by echinoderms was similar to 2012.

Most Santa Barbara Island sites continued to be dominated by echinoderms with little algae present. However, there were some dramatic changes occurring at Graveyard Canyon and Southeast Sea Lion, both inside the Marine Protected Area (MPA). Graveyard Canyon was in a state of transition, with a large increase in the ephemeral algae *Desmarestia* and more *Macrocystis pyrifera* and understory algae present compared to past years. Southeast Sea Lion also had patches of *Desmarestia* sp. and more understory algae present than in recent years. However Southeast Sea Lion continued to be dominated by *Ophiothrix spiculata.* One Santa Barbara Island site, Southeast Reef, was a mature kelp forest with an abundance of algae present. This site is one of the three newer sites that were installed in 2005 and has been the only Santa Barbara Island site to have consistently high cover of algae present in recent years. Similar to 2012, there were areas on the north side of the island that had notably more kelp than in 2011. Since most of the nearshore rocky reefs around Santa Barbara Island continue to be devoid of kelp and dominated by echinoderms, the six monitoring sites appeared to represent the overall conditions of this island.

Similar to Santa Barbara Island, most Anacapa Island sites continue to be dominated by echinoderms. The two sites in the Anacapa State Ecological Reserve that was established in 1978 (Landing Cove and Cathedral Cove) continued to be kelp forests, while the five remaining sites continued to be mostly dominated by echinoderms. The monitoring sites here appear to represent the overall conditions of this island well with echinoderms dominating most of the Island. Though there are patches of kelp surrounding the Island, there are notably more and larger patches of kelp on the north side of East and Middle Anacapa in the MPA than are present on the south non-MPA side. Similarly, there is little kelp on the north side of West Anacapa, which is a State Marine Conservation Area that does not protect most species from fishing.

Overall, sites on Santa Cruz Island remained similar to 2012 with three being kelp forests, one in a state of transition and six dominated by echinoderms. Yellowbanks, a site that often transitions between being dominated by *Strongylocentrotus* spp. and a kelp forest, was once again a kelp forest. There were increases in *S. franciscanus* and *Ophiothrix spiculata* at Gull Island and this site was in transition. Cavern Point, which transitioned into a mature kelp forest last year, continued to be a kelp forest this year. *Strongylocentrotus* spp. continues to dominate six of the 10 sites at this island, similar to past years. *Strongylocentrotus purpuratus* and *S. franciscanus* abundances around this island remained high relative to 2004–2010, similar to the past two years. Though the KFM sites as a group appropriately represent the status of kelp forests at most of the eastern two-thirds of the island, the sites under-represent the western third of the island where only one site, Gull Island, is present.

At the western portion of this island, which is in a cooler water regime, there are notably more kelp forests present than at the eastern portion.

Kelp forests continued to be abundant around Santa Rosa and San Miguel Islands. Similar to last year, mature kelp forests were present at seven of the 10 sites at these two islands and *Strongylocentrotus franciscanus* was moderately abundant to abundant at the remaining three sites. Densities of *S. purpuratus* remained low on Santa Rosa Island and decreased overall. The monitoring sites here appear to represent the conditions of these islands well with kelp forests present over much of these islands similar to recent years.

As in previous years, temperature data were collected throughout the field season (May–October); therefore we look at annual water temperatures from May 2012 to April 2013. The region experienced a warm-water event from August–December in 2012. The mean monthly temperature for all sites for October was the highest recorded since 1997 during one of the strongest El Nino/Southeren Oscilation (ENSO) events documented. San Miguel and Santa Rosa Islands continued to experience the highest monthly mean temperature recorded for November since 1997.

Acknowledgments

Funding for the kelp forest monitoring program in 2013 was entirely provided by the U.S. National Park Service (NPS) with most funding coming from the Stewardship of New Marine Protected Areas and some from the Inventory and Monitoring Program. The monitoring program is conducted in cooperation with the California Department of Fish and Wildlife (CDFW) and the U.S. Department of Commerce, National Oceanographic and Atmospheric Administration (NOAA), Marine Sanctuary Program.

We are deeply indebted to the many divers who participated in this program in 2013 (Table 7). All volunteer divers were trained and/or certified with other agencies such as NOAA, CDFW, Aquariums and/or Universities. Without this other agency and/or volunteer base of well-trained and qualified divers it would be impossible to conduct this program at its current funding level. We also greatly appreciate the efforts of our Captain Keith Duran and our Park Dive Officer Kelly Moore for ensuring that all of our operations ran safely and successfully. In addition, Lena Lee is an essential component to all aspects of KFM data management. We would like to especially thank our incredible NPS Seasonal Kelp Forest Monitoring Biological Technicians: James Grunden, Jaime McClain, Douglas Simpson and Michael Hoban.

List of Acronyms

ARM	Artificial Recruitment Module
CDFW	California Department of Fish and Wildlife (formerly California Department of Fish and Game, CDFG)
CHIS	Channel Islands National Park
CINMS	Channel Islands National Marine Sanctuary
ENSO	El Niño Southern Oscillation
KFM	Kelp Forest Monitoring Program
KGB	Kelp/Gopher/Copper/Black and Yellow Rockfish Complex young of the year
MEDN	Mediterranean Coast Network
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRPP	Natural Resources Preservation Program
PISCO	Partnership for Interdisciplinary Studies of Coastal Oceans
RPC	Random Point Contact
UCSB	University of California, Santa Barbara
YOY	Young of the Year

Introduction

The waters of Channel Islands National Park (CHIS) and Channel Islands National Marine Sanctuary (CINMS) contain one third of southern California's kelp forests (CDFW 2004). Giant kelp, *Macrocystis pyrifera*, is the primary constituent of the southern California kelp forest, and over 1,000 species of macro flora and fauna live in this community (Woodhouse 1981; Engle pers. comm.). The kelp forest serves as food, shelter, substrate, and nursery to resident and migratory species. Many species, while not residents of the kelp forest, also depend upon their existence and productivity, as detrital flux from kelp forests provides an important source of nutrients to nearby rocky shore, sandy beach and estuary communities. Additionally, kelp forests are essential to California's commercial and sport fisheries as well as its recreation and tourism industries.

CHIS consists of five (San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Santa Barbara) of the eight California Channel Islands and the submerged lands and waters within one nautical mile of each of the islands. The CINMS overlaps the subtidal portions of the park, and its boundary extends six miles seaward from the park islands. CHIS also bears the designation of International Biosphere Reserve and that of the State of California Area of Special Biological Significance. The State of California maintains jurisdiction over the living marine resources three miles from shore and manages them through CDFW.

The KFM is part of the long-term ecological monitoring conducted by the Mediterranean Coast Network (MEDN) of the NPS Inventory and Monitoring Program, which is designed to measure the health of the Park's ecosystems (Davis and Halvorson 1988). Kelp forests are considered a "Vital Sign" of ecosystem health for CHIS (Davis and Halvorson 1988). Funding for KFM in 2013 was entirely provided by the NPS with most funding coming from the Stewardship of New Marine Protected Areas and some from the Inventory and Monitoring Program. The objectives of KFM are as follows:

- Identify trends in ecosystem health
- Determine limits of variability
- Diagnose abnormal conditions
- Suggest potential remedial treatments

Following a five-year design study that began in 1982, KFM was fully implemented in 1987 by the park's resource management division using the protocol established during this phase (Davis and Halvorson 1988). Preliminary results and specific design considerations can be found in reports written by Davis (1985, 1986). The KFM annual reports listed in Table 1 describe monitoring efforts and results for years 1982–2012. A review of KFM was conducted in 1995 (Davis et al. 1996; Schroeter et al. 1994), and the Kelp Forest Monitoring Handbook (Davis et al. 1997) was updated. An additional update to the handbook is in progress.

Table 1. Summary of Kelp Forest Monitoring reports.

Report Type	Reference
Evaluation of Sampling Design for Kelp Forest Monitoring Program	Schroeter et al. 1994
Kelp Forest Monitoring Design Review	Davis et al. 1996
Annual Report 1982–89	Richards et al. 1997
Annual Report 1990	Richards, Avery, and Kushner 1993
Annual Report 1991	Richards, Kushner, and Avery 1993
Annual Report 1992	Richards and Kushner. 1994
Annual Report 1993	Kushner, Walder, et al. 1995
Annual Report 1994	Kushner, Lerma, and Richards 1995
Annual Report 1995	Kushner, Lerma, et al. 1997
Annual Report 1996	Kushner, Morgan, et al. 1997
Annual Report 1997	Kushner et al. 1998
Annual Report 1998	Kushner et al. 2000
Annual Report 1999	Kushner, Lerma, et al. 2001
Annual Report 2000	Kushner, Lerma, and Donahue 2001
Annual Report 2001	Kushner et al. 2004
Annual Report 2002	Kushner et al. 2007a
Annual Report 2003	Kushner et al. 2007b
Annual Report 2004	Kushner, Rich, and Sprague 2007
Annual Report 2005	Kushner et al. 2012
Annual Report 2006	Kushner et al. 2013
Annual Report 2007	Moore et al. 2013
Annual Report 2008	Sprague, Kushner, and Moore 2013
Annual Report 2009	Kushner et al. 2013
Annual Report 2010	Sprague et al. 2012
Annual Report 2011	Sprague, Traiger, et al. 2013
Annual Report 2012	Sprague, Civiello, et al. 2013

Though KFM was fully implemented as an Inventory & Monitoring Program prototype "vital sign" in 1987 (Davis and Halvorson 1988), monitoring began at 14 sites in 1982 and two additional sites in 1986. An additional site, Miracle Mile, was established in an area of high *Haliotis rufescens* abundance at San Miguel Island in 2001 and was partially monitored (not all KFM protocols were

conducted) from 2002–2004, and then fully monitored (all KFM protocols were conducted) since 2005. In 2005, an additional 16 permanent sites were established to collect baseline data from inside and adjacent to four of 11 new MPAs that were established in 2003. Sampling results from all 33 sites are included in this report. For additional information on protocol modifications, data management, database corrections, and additional projects information see Appendix A.

The 16 sites established in 2005 were located inside or adjacent to the following State MPAs or State Marine Conservation Areas: Santa Barbara Island MPA, Anacapa Island MPA, Scorpion Anchorage MPA at Santa Cruz Island, and South Point MPA at Santa Rosa Island. Only four of the 11 newly established MPAs were selected because of limited funding and the logistical constraints of conducting this type of monitoring. These four MPAs were chosen for the following reasons: accessibility, subjected to high fishing pressure prior to MPA implementation, and to make the best use of the KFM Program's existing baseline data. New sites were established to complement existing sites so that three sites were inside, and three sites were adjacent to each of the four MPAs, the exception being Anacapa Island which has four sites inside the MPA. This extra site was selected because it is inside a State Marine Conservation Area, which allows for take of pelagic finfish and lobster. The remaining 12 MPA reference sites are no-take MPAs, providing equal pairing with the 12 adjacent outside MPA reference sites.

This report summarizes the monitoring efforts and results from 2013, our 32nd consecutive year of monitoring. It is anticipated that this report, and others, will provide some insight into kelp forest dynamics and stimulate further research into the long-term trends and changes in this near-shore ecosystem. We have highlighted some of the most important observations and tried to provide a characterization for each site. Organisms are referred to by genus and species, except when non-indicator species are mentioned, then both scientific and common names are used. Common names for the indicator species are cross-referenced to their scientific names in Table 2. Since the design of KFM, several genera and species names have been changed; these new names are cross referenced in Table 3.

Table 2. Regularly monitored species, substrate, and associated monitoring technique(s). Monitoring techniques are described in Davis et al., 1997, and Kushner and Sprague, in progress.

Group	Taxa/Common Name	Scientific Name	Technique*
Algae	Miscellaneous green algae	–	R
	Miscellaneous red algae	–	R
	Articulated coralline algae	–	R
	Encrusting coralline algae	–	R
	Agar weed	*Gelidium* spp.	R
	Sea tongue	*Gigartina* spp.	R

* Technique codes: Q= 1m^2 quadrats, M= 5m^2 quadrats, B= Band Transects, R= Random Point Contacts, S= Size Frequency Measurements, F= Roving Diver Fish Count, V= Visual Fish Transect.

Table 2 (continued). Regularly monitored species, substrate, and associated monitoring technique(s). Monitoring techniques are described in Davis et al., 1997, and Kushner and Sprague, in progress.

Group	Taxa/Common Name	Scientific Name	Technique*
Algae (continued)	Miscellaneous brown algae	–	R
	Acid weed	*Desmarestia* spp.	R
	Oar weed	*Laminaria farlowii*	R, Q
	Bladder chain kelp	*Cystoseira* spp.	R
	Giant kelp	*Macrocystis pyrifera*	R, Q, M
	California sea palm	*Pterygophora californica*	R, Q
	Southern sea palm	*Eisenia arborea*	R, Q
	Sargassum	*Sargassum horneri*	R, Q, M, B
	Miscellaneous plants	–	R
Invertebrates	Miscellaneous sponges	–	R
	Orange puffball sponge	*Tethya aurantia*	B, S
	Southern staghorn bryozoan	*Diaperoecia californica*	R
	Miscellaneous bryozoans	–	R
	California hydrocoral	*Stylaster californica*	B, S
	White-spotted rose anemone	*Tealia lofotensis*	B
	Red gorgonian	*Lophogorgia chilensis*	B, S
	Brown gorgonian	*Muricea fruticosa*	B, S
	Californian golden gorgonian	*Muricea californica*	B, S
	Strawberry anemone	*Corynactis californica*	R
	Orange cup coral	*Balanophyllia elegans*	R
	Cup coral	*Astrangia lajollaensis*	R
	Ornate tube worm	*Diopatra ornata*	R
	Colonial sand-tube worm	*Phragmatopoma californica*	R
	Scaled-tube snail	*Serpulorbis squamigerus*	R
	Chestnut cowrie	*Cypraea spadicea*	Q
	Wavy turban snail	*Megastraea undosa*	Q, S
	Red turban snail	*Astraea gibberosa*	Q, S
	Bat star	*Patiria miniata*	Q, S

* Technique codes: Q= 1m^2 quadrats, M= 5m^2 quadrats, B= Band Transects, R= Random Point Contacts, S= Size Frequency Measurements, F= Roving Diver Fish Count, V= Visual Fish Transect.

Table 2 (continued). Regularly monitored species, substrate, and associated monitoring technique(s). Monitoring techniques are described in Davis et al., 1997, and Kushner and Sprague, in progress.

Group	Taxa/Common Name	Scientific Name	Technique*
Invertebrates (continued)	Giant-spined sea star	*Pisaster giganteus*	Q, S, M
	Ochre sea star	*Pisaster ochraceus*	M
	Sunflower star	*Pycnopodia helianthoides*	B, S
	White sea urchin	*Lytechinus anamesus*	B, S
	Red sea urchin	*Strongylocentrotus franciscanus*	Q, S
	Purple sea urchin	*Strongylocentrotus purpuratus*	Q, S
	Warty sea cucumber	*Parastichopus parvimensis*	Q
	Aggregated red sea cucumber	*Pachythyone rubra*	R
	Red abalone	*Haliotis rufescens*	B, S
	Pink abalone	*Haliotis corrugata*	B, S
	Green abalone	*Haliotis fulgens*	B, S
	Kellett's whelk	*Kelletia kelletii*	B, S
	Giant keyhole limpet	*Megathura crenulata*	B, S
	California brown sea hare	*Aplysia california*	B
	Rocl scallop	*Crassedoma giganteum*	B, S
	California spiny lobster	*Panuluris interruptus*	B
	Tunicates	–	R
	Stalked tunicate	*Styela monteryensis*	Q
	Miscellaneous invertebrates	–	R
Fish	Bluebanded goby	*Lythrypnus dalli*	Q, F
	Blackeye goby	*Coryphopterus nicholsii*	Q, F
	Island kelpfish	*Alloclinus holderi*	Q, F
	Blacksmith	*Chromis punctipinnis*	V, F
	Señorita	*Oxyjulis californica*	V, F
	Blue rockfish	*Sebastes mystinus*	V, F
	Olive rockfish	*Sebastes serranoides*	V, F
	Kelp rockfish	*Sebastes atrovirens*	V, F
	Kelp bass	*Paralabrax clathratus*	V, F
	California sheephead	*Semicossyphus pulcher*	V, F

* Technique codes: Q= 1m^2 quadrats, M= 5m^2 quadrats, B= Band Transects, R= Random Point Contacts, S= Size Frequency Measurements, F= Roving Diver Fish Count, V= Visual Fish Transect.

Table 2 (continued). Regularly monitored species, substrate, and associated monitoring technique(s). Monitoring techniques are described in Davis et al., 1997, and Kushner and Sprague, in progress.

Group	Taxa/Common Name	Scientific Name	Technique*
Fish (continued)	Black surfperch	*Embiotoca jacksoni*	V, F
	Striped surfperch	*Embiotoca lateralis*	V, F
	Pile perch	*Damalichthys vacca*	V, F
	Garibaldi	*Hypsypops rubicundus*	V, F
	Opaleye	*Girella nigricans*	F
	Rock Wrasse	*Halichoeres semicinctus*	V, F
Substrate	Bare	–	R
	Rock	–	R
	Cobble	–	R
	Sand	–	R

* Technique codes: Q= 1m^2 quadrats, M= 5m^2 quadrats, B= Band Transects, R= Random Point Contacts, S= Size Frequency Measurements, F= Roving Diver Fish Count, V= Visual Fish Transect.

Table 3. Changes in scientific nomenclature.

Current Name	Former Name
Patiria miniata	*Asterina miniata/Patiria miniata*
Chondracanthus spp.	*Gigartina* spp.
Megastraea undosa	*Lithopoma undosum / Astraea undosa*
Lithopoma gibberosa	*Astraea gibberosa*
Crassedoma giganteum	*Hinnites giganteum*
Stylaster californica	*Allopora californica*
Telia lofotensis	*Urticina lofotensis*
Coryphopterus nicholsii	*Rhinogobiops nicholsii*
Rhacochilus vacca	*Damalychthys vacca*

Methods

Abundances, and in some cases size structure, of 71 indicator taxa or categories of algae, fish, and invertebrates (Tables 2 and 3) were measured at 33 permanent sites (Table 4) around the five park islands (Figure 1). Sites #17–20 are excluded from Table 4 since they are located at San Clemente Island (outside of the park) and are no longer monitored by NPS. Additionally, all species of fish that were positively identified while the Roving Diver Fish Count and Fish Size Frequency protocols were being conducted were counted and measured. Sites were monitored between May 15 and October 19, 2013 using the NPS vessel "Sea Ranger". Site and species selection criteria and sampling protocol are described in the Kelp Forest Monitoring Handbook (Davis et al., 1997, and Kushner and Sprague, in progress). Data management and entry procedures are also described in the Kelp Forest Monitoring Handbook. Although the handbooks are in the process of being updated; an older version is available online at Kelp Forest Community Monitoring. (see also Appendix B).

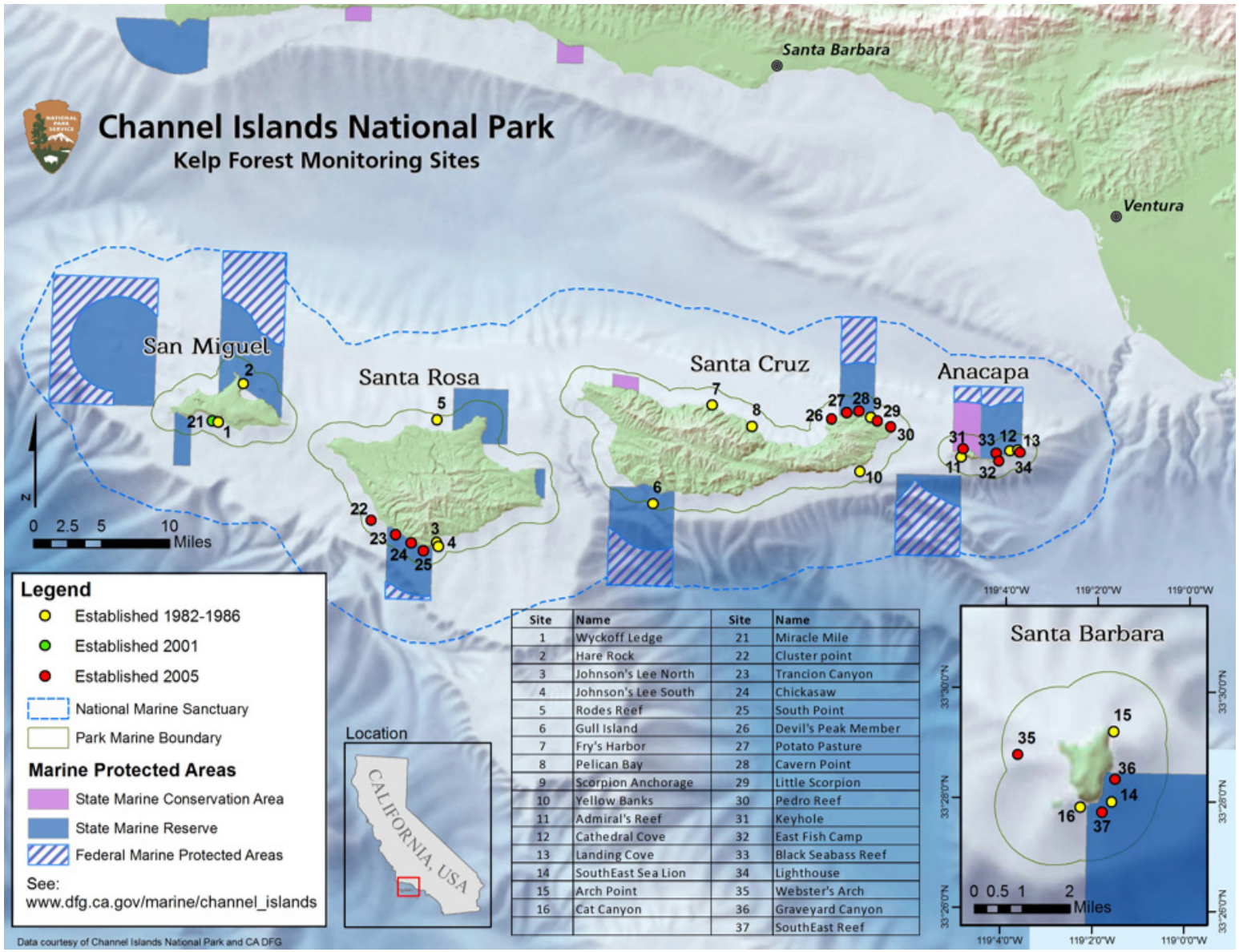
Kelp Forest Monitoring Program data usage history and request for information contact details are given in Appendix B.

Table 4. Kelp Forest Monitoring Program sampling sites information.

Island	Site Location-#	Site Abbreviation	Depth (m)	Year Established	Year MPA Established
San Miguel	Wyckoff Ledge-1	SMWL	13–15	1982	N/A
	Hare Rock-2	SMHR	6–9	1982	2003
	Miracle Mile-21	SMMM	7–10	2001	N/A
Santa Rosa	Johnson's Lee North-3	SRJLNO	9–11	1982	N/A
	Johnson's Lee South-4	SRJLSO	14–16	1982	N/A
	Rodes Reef-5	SRRR	13–15	1983	N/A
	Cluster Point-22	SRCP	12–15	2005	N/A
	Trancion Canyon-23	SRTC	9–15	2005	2003
	Chickasaw-24	SRCSAW	10–13	2005	2003
	South Point-25	SRSP	11–13	2005	2003
Santa Cruz	Gull Island South-6	SCGI	14–16	1982	2003
	Fry's Harbor-7	SCFH	12–13	1982	N/A
	Pelican Bay-8	SCPB	6–8	1982	N/A
	Scorpion Anchorage-9	SCSA	5–6	1982	2003
	Yellowbanks-10	SCYB	14–15	1986	N/A
	Devil's Peak Member-26	SCDPM	10–13	2005	N/A

Table 4 (continued). Kelp Forest Monitoring Program sampling sites information.

Island	Site Location-#	Site Abbreviation	Depth (m)	Year Established	Year MPA Established
Santa Cruz (continued)	Potato Pasture-27	SCPP	9–12	2005	2003
	Cavern Point-28	SCCVP	12–13	2005	2003
	Little Scorpion-29	SCLS	9–14	2005	N/A
	Pedro Reef-30	SCPRF	7–10	2005	N/A
Anacapa	Admiral's Reef-11	ANAR	13–15	1982	N/A
	Cathedral Cove-12	ANCC	6–11	1982	1979
	Landing Cove-13	ANLC	5–12	1982	1979
	Keyhole-31	ANKH	7–10	2005	2003
	East Fish Camp-32	ANEFC	9–14	2005	N/A
	Black Sea Bass Reed-33	ANBSBR	15–16	2005	2003
	Lighthouse-34	ANLH	7–9	2005	N/A
Santa Barbara	Southeast Sea Lion Rookery-14	SBSESL	12–14	1982	2003
	Arch Point-15	SBAR	7–8	1982	N/A
	Cat Canyon-16	SBCAT	7–9	1986	N/A
	Webster's Arch-35	SBWA	14–16	2005	N/A
	Graveyard Canyon-36	SBGC	10–12	2005	2003
	Southeast Reef-37	SBSER	10–15	2005	2003



Site	Name	Site	Name
1	Wyckoff Ledge	21	Miracle Mile
2	Hare Rock	22	Cluster point
3	Johnson's Lee North	23	Trancion Canyon
4	Johnson's Lee South	24	Chickasaw
5	Rodes Reef	25	South Point
6	Gull Island	26	Devil's Peak Member
7	Fry's Harbor	27	Potato Pasture
8	Pelican Bay	28	Cavern Point
9	Scorpion Anchorage	29	Little Scorpion
10	Yellow Banks	30	Pedro Reef
11	Admiral's Reef	31	Keyhole
12	Cathedral Cove	32	East Fish Camp
13	Landing Cove	33	Black Seabass Reef
14	SouthEast Sea Lion	34	Lighthouse
15	Arch Point	35	Webster's Arch
16	Cat Canyon	36	Graveyard Canyon
		37	SouthEast Reef

Figure 1. Kelp Forest Monitoring Locations at Channel Islands National Park.

Each of the 33 sites was marked by a 100 m long transect line affixed to the seabed with eyebolts. Thirteen different sampling techniques were used to gather data on abundance and age structure (Table 5). At each site, the following methods were performed to determine densities and distribution of discrete benthic organisms: 24 paired 1 m x 1 m quadrats systematically arranged along the transect with a random start, 40 continuous 1 m x 5 m quadrats directly along the transect, and 24 paired 3 m x 10 m band transects systematically arranged along the transect with a random start. To determine percent cover of encrusting invertebrates, algae, and substrate composition, 600 random non-adjacent points (random point contacts – RPCs) were performed.

Table 5. Summary of sampling techniques.

Technique	Area or Time Sampled	# of Replicates (per site)
1 m^2 Quadrat	1 m x 2 m	12
5 m^2 Quadrat	1 m x 5 m	40
Band Transect	3 m x 20 m	12
Random Point Contact	40 points (0.5x3)	15
Visual Fish Transect	2 m (w) x 3 m (h) x 50 m (l)	4
Fish Size Frequency	30 minutes minimum	1 (minimum)
Roving Diver Fish Count	30 minutes	4–8 observers
Video Transect	100 m, 5 minutes	2
Video Plot	360º pan of bolt, 360º pan of water column	3 (0 m, 50 m, and 100 m marks)
Natural Habitat Size Frequency	individual	30–200 per select species
Artificial Recruitment Module	module, time variable	5–15
Species Checklist	30–90 minutes	1
Temperature	Hourly	all sites

To determine fish density, four 2 m x 3 m x 50 m fixed transects were performed. To determine fish abundance and diversity, timed Roving Diver Fish Counts (RDFC) were performed. The RDFCs were conducted using three to seven expert observers for each site. An expert observer is defined as someone who can confidently identify and accurately count all species of fishes that commonly occur at the Channel Islands. Each of the three to seven observers collected replicate data. To estimate fish population size structure, size frequencies of all fish observed within 10 m of the transect, and from surface to benthos, were visually measured, excluding schooling baitfish and cryptic species. All fish transects, fish size frequencies, and RDFC surveys were conducted between 0900 and 1500 hours unless otherwise noted.

Population data for fishes were collected using the four protocols (Table 6). Briefly these are: (1) 1 m^2 quadrats for several small benthic cryptic species, (2) visual fish transect for a select group of

indicator species, (3) roving diver fish counts for all species and (4) size frequencies for most species. See the Kelp Forest Monitoring Handbook (Davis et al. 1997; and Kushner and Sprague, in progress) for detailed descriptions of the different protocols. Any fish indicator species not observed during the 1 m^2 quadrat, roving diver fish count, or visual fish transect protocols, were recorded as zeros. All non-indicator species were given null values if not observed.

Table 6. List of fish monitoring protocols.

Protocol (and metric measured)	**Fish Species Monitored**	**Fish Species Excluded**
1 m^2 quadrats (density)	*Coryphopterus nicholsii, Alloclinus holderi* and *Lythrypnus dalli*	All others
Roving diver fish count (count/abundance)	All species of fish	None
Visual fish transects (density)	Indicator species only	Non-indicator species
Fish size frequencies (size distribution)	Most species of fish	Gobies, cryptic/benthic species, and *Girella nigricans*

During data collection, visual fish transects were performed before the other three fish protocols. Once visual fish transects were completed, the roving diver fish count and fish size frequencies protocols were performed simultaneously. Benthic fishes were sampled last using the 1 m^2 quadrat protocol.

Videotaped transects were performed to document site appearance. Size frequency measurements were collected to determine age structure and recruitment cohorts (Table 7). All animals measured for the natural habitat size frequency distributions were located using a band transect type search method. If there is less than the minimum sample size at a site, an effort is made to measure as many individuals as can be located. Artificial recruitment modules (ARMs) were in place at 11 of the sites to measure recruitment and population structure of indicator species within the ARMs. A general species list was established for each site, noting presence/absence and relative abundance for all positively identified species (Appendix C). A description of all monitoring protocols, including schematics can be found in Davis et al. 1997 and in Kushner and Sprague, in progress.

Table 7. Size frequency measurement dimensions.

Scientific Name	Sample Size	Measurement
Macrocystis pyrifera	100	Stipe count (1 m above bottom), max. holdfast diameter, mm
Tethya aurantia	60	Max. diameter, mm
Stylaster (Allopora) californica	60	Max. height and width, mm
Lophogorgia chilensis	60	Max. height and width, mm
Muricea californica	60	Max. height and width, mm
Megathura crenulata	60	Max. shell length, mm
Haliotis spp.	60	Max. shell length, mm
Megastraea (Lithopoma/Astraea) undosa	60	Max. shell diameter, mm
Astraea (Lithopoma) gibberosa	60	Max. shell diameter, mm
Kelletia kelletii	60	Max. shell length, mm
Crassedoma (Hinnites) giganteum	60	Max. shell length, mm
Tegula regina	60	Max. shell length, mm
Strongylocentrotus spp.	200	Max. shell diameter, mm
Lytechinus anamesus	200	Max. shell diameter, mm
Pycnopodia helianthoides	60	Length of longest ray, mm
Asterina (Patiria) miniata	60	Length of longest ray, mm
Pisaster giganteus	60	Length of longest ray, mm

Hourly temperature data were collected using remote temperature loggers at 32 sites, the exception being Miracle Mile where there is no temperature logger installed. Temperature data have been collected continuously since 1994/95, except a few intances where loggers malfunctioned or were lost or stolen. Remote temperature loggers, TIDBIT® (Onset Computer Corporation), were encased in underwater housings and attached to stainless steel thread rods cemented to the bottom at each site. At least two temperature loggers per site were deployed. A comparison of temperature data from both loggers were conducted to ensure that the loggers were recording within their specifications (± 0.2 °C).

We attempted to complete all abundance-related data collection techniques (1 m^2 quadrats, 5 m^2 quadrats, band transects, random point contacts, roving diver fish counts, fish transects and fish size frequencies) and retrieve/deploy temperature loggers during the same visit. During the remaining sampling visits, we sometimes conducted size frequency sampling, transect line repair as well as RDFC and fish size frequency protocols a second time if time allowed. On rare occasions the abundance techniques are not completed during our first visit and are completed at subsequent visits as soon as possible. If this happens, it is documented under the site information Appendix D. If there

appears to be large changes in abundance between visits within a sampling season, an additional sampling may be conducted to document these changes, but this is a rare occurrence.

Results/Discussion

All prescribed sampling was completed at all 33 monitoring sites in 2013. ARMs were monitored at all 12 sites where they were present. Two cruises were cancelled; one because of an NPS-wide diving stand down due to a dive incident at another park, and the second because of a Federal Government shutdown due to a lapse in appropriations. Sixteen divers (Table 8) collected data on eight five-day cruises, one four-day cruise and one single-day cruise between May 13 and October 22 (Table 9). KFM divers logged 938 dives with over 863 hours of dive time.

Table 8. 2013 KFM participant list.

Participant	Affiliation	Cruises
Duran, Keith	Channel Islands National Park	All Cruises
Grunden, James	Channel Islands National Park	All Cruises
Hoban, Michael	Channel Islands National Park	1,2,3,4,5,6,7,8
Kushner, David	Channel Islands National Park	All Cruises
Mason, Julia	Our World Underwater Scholarship Society Intern	6
McCauley, Merrill	Channel Islands National Park	8
McClain, Jaime	Channel Islands National Park	All Cruises
Moore, Kelly	Channel Islands National Park	1,2,3,4,5,6,8,9
Moss, Michael	Tierra Data Incorporated	5
Nimz, Jim	American Samoa National Park	3
Schonder, Chuck	University of California, Santa Barbara	4
Simpson, Douglas	Channel Islands National Park	All Cruises
Sprague, Joshua	Channel Islands National Park	All Cruises
Whitaker, Steve	Channel Islands National Park	1,2
Williams, Ian	Channel Islands National Park	7
Witting, David	National Oceanic and Atmospheric Administration	9

Table 9. 2013 Kelp forest monitoring cruise list.

Cruise #	Cruise Dates	KFM Sites Visited*
Cruise #1	05/13–05/17	SBSESL, SBWA, SBAP, SBGC, ANCC
Cruise #2	05/28–05/31	ANLH, ANCC, ANEFC
Cruise #3	06/10–06/14	ANKH, SBCAT, SCLS, SCDPM, SBSER
Cruise #4	06/24–06/28	ANLC, SCFH, SRJLSO, SCGI, SRTC
Cruise #5	07/15–07/19	SRJLSO, SRCSAW, SCPRF, SRJLNO, ANAR, SRSP
Cruise cancelled	07/29–08/02	Cancelled due to NPS Dive Program stand-down
Cruise #6	08/12–08/16	ANLC, ANLH, SRJLNO, SRCP, SMMM
Cruise #7	08/21–08/21	ANAR
Cruise #8	08/26–08/30	SCSA, SCYB, SCPP, ANBSBR
Cruise #9	09/16–09/20	SCPB, SRRR, SCYB, SCCVP
Cruise cancelled	09/30–10/04	Cancelled due to government shutdown
Cruise #10	10/18–10/22	SCGI, SMHR, ANCC, SMWL

* See Table 4 for site information, including a key to site names.

Mean densities for 1 m^2 quadrats represent average counts obtained from 24 paired 1 m x 1 m quadrats or otherwise described as twelve 2 m^2 quadrats (Appendix E, 1 Meter Quadrat Data). Mean densities for 5 m^2 quadrats represent average counts obtained from 40 continuous and adjacent 1 m x 5 m quadrats (Appendix F, 5 Meter Quadrat Data). Mean densities for band transects represent average counts obtained from 24 paired 3 m x 10 m transects or otherwise described as twelve 3 m x 20 m transects (Appendix G, Band Transect Data). Mean percent cover for random point contacts represent average percent cover obtained from 600 points obtained from 15 quadrats of 40 points each (Appendix H, Random Point Contact Data). Percent cover for all categories combined may total more than 100% due to layering (Davis et al. 1997). Only currently sampled species are described. Species that were monitored in past years, but not for the current year are not described. For a complete record of sampling history, refer to the Kelp Forest Monitoring Handbook (Davis et al. 1997, and Kushner and Sprague, in progress).

Summary data from fish transects are provided in Appendix I. Summary data for RDFCs, and fish size frequency measurements are provided by Lee (2018) on IRMA (https://irma.nps.gov/DataStore/Reference/2259603). Summary data from natural habitat size frequency measurements for all indicator species were collected from all sites unless very rare or absent at a site, and are provided on IRMA (https://irma.nps.gov/DataStore/Reference/2259603). Measurement dimensions and minimum sample size for each species are listed in Table 7.

ARM size frequency measurement data were collected for the same species listed in Table 7, if present, at all sites where ARMs are deployed. These data are summarized in the workbook on

IRMA (https://irma.nps.gov/DataStore/Reference/2259603). *Parastichopus parvimensis* found in the ARMs are counted and grouped into size classes of greater than or less than 10 cm.

Video transects were completed for all locations and are stored on the park's resource management server in Ventura, California. Additional information on individual sites, species observed, and temperature data can be found in the appendices. For details on survey dives see Appendix J.

The purpose of the discussion section in this report is to summarize and condense our general observations at the monitoring sites for this year. We would like to emphasize that we present only general trends and observations. A statistical trend analysis for each of the indicator species is beyond the scope of this report.

Additional information on unusual and non-indicator species is presented in Appendix K.

Kelp Forests

The status of kelp forests was notably different between the five park islands. This is a result of a combination of factors including but not limited to, oceanography, biogeography and associated differences in species abundance and composition, as well as sport and commercial fishing pressure. All 33 permanent sites were established in areas that had or were historically known to have had kelp forests in the past.

In 2013, 13 of the 33 sites monitored were characterized as kelp forests. In addition, three sites were in a state of transition seemingly towards kelp forests. The remaining 17 sites were mostly dominated by echinoderms consisting of sea urchins and spiny brittle stars, *Ophiothrix spiculata*. Overall, the total number of sites characterized by kelp forests or dominated by echinoderms was similar to 2012.

The echinoderm species that dominated 15 sites are listed in Table 10, including the 2012 site status characterization for comparison.

Table 10. 2013 Kelp forest monitoring site status with 2012 status for comparison.

Island	Site	2013 Status	2012 Status
San Miguel	Wyckoff Ledge	Mature kelp forest	Mature kelp forest
	Hare Rock	Dominated by *S. franciscanus*	Dominated by *S. franciscanus*
	Miracle Mile	Mature kelp forest	Mature kelp forest
Santa Rosa	Johnson's Lee North	Mature kelp forest	Mature kelp forest
	Johnson's Lee South	Mature kelp forest	Mature kelp forest
	Rodes Reef	Open area with moderately high density of *S. franciscanus*	Open area with moderately high density of *S. franciscanus*
	Cluster Point	Mature kelp forest	Mature kelp forest
	Trancion Canyon	State of transition	State of transition

Table 10 (continued). 2013 Kelp forest monitoring site status with 2012 status for comparison.

Island	Site	2013 Status	2012 Status
Santa Rosa (continued)	Chickasaw	Mature kelp forest	Mature kelp forest
	South Point	Mature kelp forest	Mature kelp forest
Santa Cruz	Gull Island South	State of transition	State of transition
	Fry's Harbor	Mature kelp forest	Mature kelp forest
	Pelican Bay	Dominated by *S. purpuratus*	Dominated by *S. purpuratus*
	Scorpion Anchorage	Dominated by *Strongylocentrotus* spp	Dominated by *Strongylocentrotus* spp
	Yellowbanks	Kelp forest	State of transition
	Devil's Peak Member	Dominated by *Strongylocentrotus* spp	Dominated by *Strongylocentrotus* spp
	Potato Pasture	Dominated by *S. purpuratus*	Dominated by *S. purpuratus*
	Cavern Point	Kelp forest	Mature kelp forest
	Little Scorpion	Dominated by *Strongylocentrotus* spp	Dominated by *Strongylocentrotus* spp
	Pedro Reef	Dominated by *Strongylocentrotus* spp	Dominated by *Strongylocentrotus* spp
Anacapa	Admiral's Reef	Dominated by *O. spiculata*	Dominated by *O. spiculata*
	Cathedral Cove	Mature kelp forest	Mature kelp forest
	Landing Cove	Kelp forest	Mature kelp forest
	Keyhole	Dominated by *S. purpuratus*	Dominated by *Strongylocentrotus* spp.
	East Fish Camp	Dominated by *Strongylocentrotus* spp. and *O. spiculata*	Dominated by *Strongylocentrotus* spp. and *O. spiculata*
	Black Sea Bass Reed	Dominated by *O. spiculata*	Dominated by *O. spiculata*
	Lighthouse	Dominated by *Strongylocentrotus* spp.	Dominated by *Strongylocentrotus* spp.
Santa Barbara	Southeast Sea Lion Rookery	Dominated by *O. spiculata*	Dominated by *S. purpuratus* and *O. spiculata*
	Arch Point	Dominated by *Strongylocentrotus* spp.	Dominated by *Strongylocentrotus* spp.
	Cat Canyon	Dominated by *S. purpuratus*	Dominated by *S. purpuratus*

Table 10 (continued). 2013 Kelp forest monitoring site status with 2012 status for comparison.

Island	Site	2013 Status	2012 Status
Santa Barbara (continued)	Webster's Arch	Dominated by *S. purpuratus* and *O. spiculata*	Dominated by *S. purpuratus* and *O. spiculata*
	Graveyard Canyon	State of transition	Dominated by *S. purpuratus* and *O. spiculata*
	Southeast Reef	Mature kelp forest	Mature kelp forest

Most of the Santa Barbara Island sites continued to be dominated by echinoderms with little algae present. However, there were some dramatic changes occurring at Graveyard Canyon and Southeast Sea Lion, both inside the MPA. Graveyard Canyon was in a state of transition, with a large increase in the ephemeral algae *Desmarestia* sp. and more *Macrocystis pyrifera* and understory algae present compared to past years. Southeast Sea Lion also had patches of *Desmarestia* sp. and more understory algae present than in recent years, however it continued to be dominated by *Ophiothrix spiculata.* Southeast Reef was a mature kelp forest with large, widely-spaced *M. pyrifera* plants, and an abundance of other algae present. This site is one of the three newer sites that were installed in 2005 and has been the only Santa Barbara Island site to have consistently high cover of algae present in recent years. Similar to 2012, there were areas on the north side of the island that had notably more kelp than in 2011. Since most of the nearshore rocky reefs around Santa Barbara Island continue to be devoid of kelp and dominated by echinoderms, the six monitoring sites appear to represent the overall conditions of this island.

Similar to Santa Barbara Island, most Anacapa Island sites continued to be dominated by echinoderms. The two sites (Landing Cove and Cathedral Cove) in the Anacapa State Ecological Reserve, which was established in 1978, continued to be kelp forests while the five remaining sites continued to be mostly dominated by echinoderms. The monitoring sites here appear to represent the overall conditions of this island well with echinoderms dominating most of the Island. Though there are patches of kelp surrounding the island, there are notably more and larger patches of kelp on the north side of East and Middle Anacapa in the MPA than on the south non-MPA side or on the north side of West Anacapa which is a State Marine Conservation Area that does not protect all species from fishing.

Overall, sites on Santa Cruz Island remained similar to 2012 with three being kelp forests, one in a state of transition and six dominated by echinoderms. Yellowbanks, a site that often transitions between domination by *Strongylocentrotus* spp. and a kelp forest, was once again a kelp forest. There were increases in *S. franciscanus* and *Ophiothrix spiculata* at Gull Island and this site was in transition. Cavern Point, which transitioned into a mature kelp forest last year, continued to be a kelp forest this year. *Strongylocentrotus* spp. continues to dominate six of the 10 sites at this island, similar to past years. *Strongylocentrotus purpuratus* and *S. franciscanus* abundances around this island remained high relative to 2004–2010, similar to the past two years. Though the KFM sites as a group appeared to appropriately represent the status of kelp forests at most of the eastern two-thirds

of the island, the sites do under-represent the western third of the island where only one site is present, Gull Island. At the western portion of this island, which is in a cooler water regime, there are notably more kelp forests present than at the eastern portion.

Kelp forests continued to be abundant around Santa Rosa and San Miguel Islands. Similar to last year, mature kelp forests were present at seven of the 10 sites at these two islands and *Strongylocentrotus franciscanus* was moderately abundant to abundant at the remaining three sites. Densities of *S. purpuratus* remained low on Santa Rosa Island and decreased overall. The monitoring sites here appear to represent the conditions of these islands well with kelp forests present over much of these islands similar to recent years.

Algae

The percent cover of green algae remained similar to past years, except for at Webster's Arch, Santa Barbara Island. There, green algae cover increased to the highest cover recorded at any KFM site since 2006. At Hare Rock, San Miguel Island, green algae consisted mainly of *Ulva* sp., an ephemeral alga.

Adult *Macrocystis pyrifera* increased at San Miguel and Santa Rosa Island sites, while remaining similar at sites as the three southern islands, Santa Barbara, Anacapa and Santa Cruz Islands. Subadult densities declined at San Miguel and Santa Rosa Islands, while remaining similar at the remaining three southern islands. Overall, densities remained similar to the last 10 years. Percent cover of *M. pyrifera* (on RPCs) remained similar to the last three years.

Note that densities for adult *Macrocystis pyrifera* are collected on both 1 m^2 quadrats and 5 m^2 quadrats. Densities from both sampling protocols are graphed separately (see Appendix E, 1 Meter Quadrat Data, and Appendix F, 5 Meter Quadrat Data). *Macrocystis pyrifera* has been sampled on 1 m^2 quadrats since KFM began collecting data in 1982. After a program review was conducted in 1996, it was determined that the power to detect changes in abundance of adult *M. pyrifera* was too low. To obtain a higher power to detect change in this species abundance, the 5 m^2 quadrat protocol was implemented. In addition, subadult *M. pyrifera* were separated out from adults and sampled on the 5 m^2 quadrat protocol as well. This species continues to be sampled on 1 m^2 quadrats to maintain comparability with the years prior to 1996.

Adult *Eisenia arborea* densites increased overall. A total of four sites had record high densities. Percent cover of *E. arborea* (RPCs) remained similar to the last five years at all islands except San Miguel Island, which decreased at Miracle Mile. Adult density increased at Santa Cruz Island overall and remained similar to recent years at the other islands.

Pterygophora californica adult and juvenile densities remained similar to past years, except at Landing Cove, Anacapa Island where there was large increase. Cover of *P. californica* remains at record high at Landing Cove, Anacapa Island, similar to the last two years. Cover of *P. californica* at Cluster Point, Santa Rosa Island continued to decline for the third consecutive year from a record high density but is now similar to when we began monitoring this site in 2005. *Pterygophora californica* percent cover has fluctuated at several of the Southern Santa Rosa Island sites. Overall

cover at remaining sites is low and varies little. This alga is habitat specific and many of the KFM sites are poor habitat for this species. *Pterygophora californica* was observed at 12 KFM sites.

Laminaria farlowii adult and juvenile densities remained highest at Cathedral Cove and Landing Cove, Anacapa Island similar to the past 10 years. These two sites are in the old MPA, which established in 1978. Adult and juvenile density as well as percent cover remained relatively high at Johnson's Lee North, Santa Rosa Island compared to the first 25 years of monitoring. Similarly, abundance and cover at Yellowbanks, Santa Cruz Island was the highest recorded since 1997. While not an indicator species, several *L. setchellii* were observed at Miracle Mile, San Miguel Island and Cluster Point, Santa Rosa Island. This is a cooler water species that is rarely observed South of Point Conception.

In 2009, the first observation of the non-native invasive alga *Sargassum horneri* in CHIS was detected. *Sargassum horneri*, native to Asia (Japan, Korea, China and Vietnam), was first observed in California at Long Beach Harbor in October 2003. It has rapidly spread in southern California and in Baja, where it primarily occupies rocky habitat from 3–18 m. At the California Channel Islands, it was first observed at Catalina Island in April of 2006, then San Clemente Island in May of 2007 (Jack Engle and Kathy Ann Miller, personal communication). In April of 2009, it was first observed within Channel Islands National Park at West Anacapa Island. Small plants were observed around Rat Rock at the west end of Anacapa Island and by October, it was well established with a notably higher density of both small and large plants, some at or near maturity. We conducted additional surveys in October 2009 and *S. horneri* was observed at six out of nine survey locations at Anacapa Island (Kushner et. al, 2009). At that time, there appeared to be higher abundances on the north side of the island which had fewer *Strongylocentrotus* spp. than on the south side. Also, this area is within the State MPA or Conservation Area.

In 2010, KFM added *Sargassum horneri* to the four core abundance sampling methods to begin collecting consistent information across all five park islands on this new invasive alga. Below we report the density data for 1 m^2 quadrats, 5 m^2 quadrats, band transects and cover from random point contacts. Because we are still unsure of how abundant this species will be, it is still unclear which of these methods is the most effective for monitoring this species, so we will likely continue to collect density data from all four methods during the 2014 sampling season.

Sargassum horneri is an annual species. The alga begins to recruit around October, when KFM completes its monitoring, and peak growth appears to be in fall and winter. By May, when the KFM monitoring season begins, the alga has typically begun to senesce. This apparent rapid growth in fall, with mature plants developing in winter and spring, will mostly be missed by the monitoring program. In the summer, when most of the monitoring is conducted, the alga has already senesced. However, with that mentioned we typically can identify recently scenesced adult plants, so we count them when identified to obtain densities that will at least be partly relative to their winter adult abundances.

Sargassum horneri was observed at a total of nine KFM sites this year, an increase from four sites in 2012, five sites in 2011, and seven sites in 2010. Overall, *S. horneri* abundance increased in density

substantially at several Santa Cruz Island and Anacapa Island sites. This increase may have been due to the warm water conditions experienced in the summer and fall of 2012. Prior to the warm water event, this species had not increased in abundance as was expected. This species has not been documented at Santa Rosa or San Miguel Islands and continues to become more abundant at the southern and warmer Channel Islands.

Overall cover of *Cystoseira* spp. was similar to past years. *Desmarestia* spp. category that is used for the RPC protocol is typically all *Desmarestia ligulata*. This is a fast-growing ephemeral alga that is highly variable from year to year. *Desmarestia* spp. cover increased at Graveyard Canyon, Santa Barbara Island to a record high and remained low at all other sites. In recent years, cover of *Desmarestia* spp. has fluctuated at several Santa Barbara Islands sites. At sites with high cover of *Ophiothrix spiculata*, such as Graveyard Canyon, Santa Barbara Island, it appears that *Desmarestia* spp., a low-lying and fast-growing ephemeral alga, may physically displace *O. spiculata*, sweeping them away during high swell events. This process could be an intermediate stage between a brittle star dominated area and kelp forest. Though not picked up by the RPC monitoring protocol, *Desmarestia* sp. was present just off site of Pelican Bay, Santa Cruz Island on the offshore side in soft sandy bottom.

Cover of miscellaneous brown algae remained similar to recent years. This category is often *Dictyota* sp., *Pachydictyon* sp. and similar algae. There were increases at Graveyard Canyon, Santa Barbara Island and Cavern Point, Santa Cruz Island. At Wyckoff Ledge, San Miguel Island, cover decreased to the lowest recorded at that site since 2004.

Cover of *Gelidium* spp. remained similar to past years. The only site with notable abundance continued to be Landing Cove, Anacapa Island. This category *Gelidium* typically consists mostly of *Gelidium robustum*. Santa Rosa Island was the only island with a notable amount of *Gigartina* spp. All other sites changed little though overall cover is lower than the past several years. The category of *Gigartina* typicaly consists mostly of *Gigartina corymbifera*. Cover of miscellaneous red algae remained similar to recent years. Cover at Wyckoff Ledge, San Miguel Island decreased, but could be because of the late season sampling this year. Cover of articulated coralline algae remained similar to past years. Cover of encrusting coralline algae remained similar to past years at Santa Barbara, Santa Cruz, Anacapa, and San Miguel Island sites. At Cluster Point, Santa Rosa Island, Trancion Canyon, Santa Rosa Island, and Rodes Reed, Santa Rosa Island, cover was high compared to recent years.

Invertebrates

Porifera

Tethya aurantia densities averaged by island, remained at or near all-time highs at all five park islands. The abundance of *T. aurantia* has steadily increased over the last decade, likely due to the cold-water regime that the region has been experiencing. At Pedro Reef and Devil's Peak Member, Santa Cruz Island, many were covered with diatom film which overall is not uncommon. At Black Sea Bass Reef, Anacapa Island, *T. aurantia* were difficult to see and took longer than expected to count due to the high abundance of brittle stars covering the bottom.

Overall, sponge cover decreased from last year. The greatest decreases were at San Miguel and Santa Rosa Island sites, which had higher cover than Santa Cruz, Anacapa, and Santa Barbara Island sites. *Spheciospongia* sp. were common at some San Miguel and Santa Rosa island sites, and the Webster's Arch site on Santa Barbara Island. At Landing Cove, Anacapa Island, yellow sulfur sponge was common, as usual for this site. Additionally, several *Tylodina fungina* associated with this sponge were observed at Landing Cove, Anacapa Island.

Anthozoa/Hydrozoa

Urticina lofotensis has gradually increased in density at Santa Rosa and San Miguel Island sites over the last decade. This is a cooler water species that we expect to do well in cooler water regimes. Four sites experienced record high densities. *Corynactis californicus* cover remained similar to recent years. Pedro Reef continued to have the highest ever recorded cover at any KFM site. The *C. californicus* at Scorpion Anchorage, Santa Cruz Island, Devil's Peak Member, Santa Cruz Island, Potato Pasture, Santa Cruz Island, Southeast Sea Lion Rookery, Santa Barbara Island, and Arch Point, Santa Barbara Island appeared unhealthy (skinny-looking). *Balanophyllia elegans* cover was similar to recent years. The cover of this species has remained relatively low since 1996 compared to years prior. Individuals at Trancion Canyon, Santa Rosa Island were notably large. *Astrangia lajollaensis* cover increased at four sites and remained similar to last year at the remaining sites.

Stylaster californica continued to be present at Gull Island, Santa Cruz Island with their density remaining relatively high since 2007. One small colony was observed at Webster's Arch, Santa Barbara Island, for the first time last year. This year, the colony was detected by the band transect monitoring protocol. There was a larger population of *S. californica* several hundred meters to the north of Webster's Arch. These were the only two sites where *Stylaster californica* was observed. Overall, *Lophogorgia chilensis* densities have continued to slowly decrease at Santa Rosa, Santa Barbara, and Anacapa island sites, since the 1990s. At Pelican Bay, Santa Cruz Island, many of the *L. chilensis* lacked polyps and were covered with silt. At Admiral's Reef, Anacapa Island, *L. chilensis* were common, but most did not appear healthy. At Southeast Sea Lion Rookery, Santa Barbara Island and Black Sea Bass Reef, Anacapa Island, many appeared unhealthy and possibly senescing. At Graveyard Canyon, Santa Barbara Island, many *L. chilensis* were being smothered by *Ophiothrix spiculata* and appeared unhealthy. *Muricea californica* densities were similar to last year. *Muricea fruticosa* densities were similar to last year with no notable trends.

Annelida/Polychaeta

Diopatra ornata cover was similar to last year, overall. Cover at Lighthouse, Anacapa Island continued to decline since the site was established in 2005. This species was observed at 32 sites. This species is often highly variable in abundance and can be caused by its patchy distribution of habitat. The *D. ornata* at Fry's Harbor, Santa Cruz Island appeared notably large. *Phragmatopoma californica* cover remained the highest at Santa Rosa Island sites, similar to past years. There was a notable increase at Cat Canyon, Santa Barbara Island in 2011 and cover remained at near record high cover. At Hare Rock, San Miguel Island, *P. californica* were notably small. *Serpulorbis squamigerus* abundance was similar to last year.

Bryozoa

Overall, *Diaperoecia californica* abundance decreased at the islands where it is most abundant, Anacapa and Santa Cruz. Most of the decreases occurred at Landing Cove, Anacapa Island and Cavern Point, Santa Cruz Island, which were at record high cover last year. Percent cover remained relatively low at the remaining islands. Overall, miscellaneous bryozoan cover (excluding *Diaperoecia californica)* increased compared to recent years. Cathedral Cove, Anacapa Island, Southeast Reef, Santa Barbara Island, and South Point, Santa Rosa Island experienced the greatest increase from last year. Fry's Harbor, Santa Cruz Island remained at near record low cover for this site.

Arthropoda/Crustacea

In recent years we have observed a trend of increasing lobster abundance at the monitoring sites inside the MPAs established in 2003. Even though the monitoring sites were not selected for prime daytime (den) lobster habitat, we have seen increasing densities of lobster as they spill over into less optimal den habitat found at many KFM sites. Also, while KFM does not monitor lobster size, it is obvious that they are now significantly larger inside the MPAs than outside. This year*, P. interruptus* densities continued to be more abundant inside the MPAs at Anacapa and Santa Cruz islands than outside. The greatest increase in density occurred at Black Sea Bass Reef, Anacapa Island, which had the highest density of all sites. Densities at Santa Barbara and Santa Rosa Island sites were too low to discern any notable difference inside versus outside the MPA. However, off-site observations suggest that they were more abundant inside the MPAs at these Islands as well. At Gull Island, Santa Cruz Island and Cathedral Cove, Anacapa Island, *P. interruptus* were more abundant during second visits to those sites later in the field season, after band transect surveys had been conducted. Though Cavern Point, Santa Cruz Island had a record high density, *P. interruptus* appeared less abundant than in recent years.

Mollusca

Megastraea undosa densities continued to decline and are at or near record low abundances at KFM sites since monitoring began with the exception of Webster's Arch at Santa Barbara Island, where recent recruitment was observed. There was little change at the remaining islands/sites. This is a warmer water species whose densities cycle with warmer water conditions. The pattern in density changes we have observed in *M. undosa* of increasing abundance post the 1997/98 El Niño, and decrease in mean size, followed by a decline in abundance and increase in mean size, is similar to what was observed post the 1982/83 El Niño (Zacharias and Kushner 2006). We have not observed a widespread significant recruitment event since 1997/1998. Overall, their sizes were higher than average but there is high variability between sites. Most individuals were relatively large in size but rare at Santa Rosa Island sites. They were also rare in the ARMs.

Lithopoma gibberosa continued to be common at only a few KFM sites. *Lithopoma gibberosa* adults were common and juveniles were moderately abundant at Webster's Arch, Santa Barbara Island. Here we observed high recruitment with many individuals 20–30 mm size. This site had the highest density of this species recorded of all KFM sites since the program was implemented. It is rare to observe this many *L. gibberosa* at the southern islands. It should be noted that in 2012 we observed

several < 10 mm *L. gibberosa* which indicated a notable recruitment event. This year small < 25 mm individuals were more abundant than David Kushner (Park marine biologist) had recalled observing in 23 years of diving for KFM. At Hare Rock, San Miguel Island we observed a decline in *L. gibberosa*. It is not uncommon to observe a decline like this following a large recruitment event like was observed in 2012. No *L. gibberosa* juveniles were observed at Hare Rock, San Miguel Island this year, but last year recruits were common. They remained relatively abundant at Rodes Reef, Santa Rosa Island. At Yellowbanks, Santa Cruz Island, they were relatively abundant, but few were found directly along the transect.

There were no notable trends for *Tegula regina* abundances. This is a warmer water species and typically more abundant at the warmer water sites.

Megathura crenulata densities declined from the relatively high abundances recorded at Santa Cruz and Anacapa Islands. However, overall densities remain high compared to the last five years. At the northern islands, most individuals were larger; at the southern islands, individuals were smaller. Inversely, they are more abundant at the southern islands and less abundant at the northern islands. At Fry's Harbor, Santa Cruz Island, four separate pairs of *Megathura crenulata* were observed on top of each other, and at Yellowbanks, Santa Cruz Island, at least three individuals were observed spawning. At East Fish Camp, Anacapa Island, *M. crenulata* were common and most were very small and tucked deep in cracks and crevices. *Megathura crenulata* density in the ARMs was similar to recent years. We continued to see low-level, but regular recruitment of juveniles in them.

Overall, *Crassedoma giganteus* abundance remained similar to recent years. *Crassedoma giganteus* densities increased at three sites. Densities at Anacapa Island sites remained at near record lows compared to the first 20 years of monitoring. However, we should note that at sites inside MPAs at Anacapa Santa Cruz, and Santa Barbara Islands they are notably more abundant and larger.

Kelletia kelletii densities remained similar at all sites. Wyckoff Ledge, San Miguel Island continued to have the highest density of all the monitoring sites. A record number of small *Kelletia kelletii,* less than 40 mm, were in the ARMs this year at Yellowbanks, Santa Cruz Island and Landing Cove, Anacapa Island. Landing Cove is the only site where we consistently see juveniles of this species.

Cypraea spadicea densities overall were similar to last year. *Cypraea spadicea* densities in the ARMs increased at Santa Rosa, Santa Cruz, and Anacapa Islands and were at or near record highs.

Overall densities of *Aplysia californica* remained low at Santa Rosa, Santa Cruz, and San Miguel Island sites, similar to past years. There were decreases at Cat Canyon, Santa Barbara Island and East Fish Camp, Anacapa Island. There was an increase at Hare Rock, San Miguel Island, where most *A. californica* were juveniles. Mating aggregations were observed at Fry's Harbor, Santa Cruz Island and Lighthouse, Anacapa Island. Though not an indicator species, *Aplysia vaccaria* were observed at Fry's Harbor, Santa Cruz Island, Cathedral Cove, Anacapa Island, and Arch Point, Santa Barbara Island. This species is commonly observed at Cathedral Cove, Anacapa Island.

All species of abalone continue to be below historic abundances where data are available. At the sites where *Haliotis rufescens* have been present in the last 10 years, densities were similar to recent years.

Most *H. rufescens* observations continued to be at San Miguel and Santa Rosa Islands. Miracle Mile, San Miguel Island, the site adjacent to Wyckoff Ledge that was installed in 2001 specifically to monitor *H. rufescens,* continued to have a high density. This site was purposely established in an area of high density, which is why it is graphed separately from the remaining 32 KFM sites (Figure 2). Areas selected for the highest density possible are more likely to decrease in density than increase. The density at this site has been relatively stable for the past six years after its rapid initial decline.

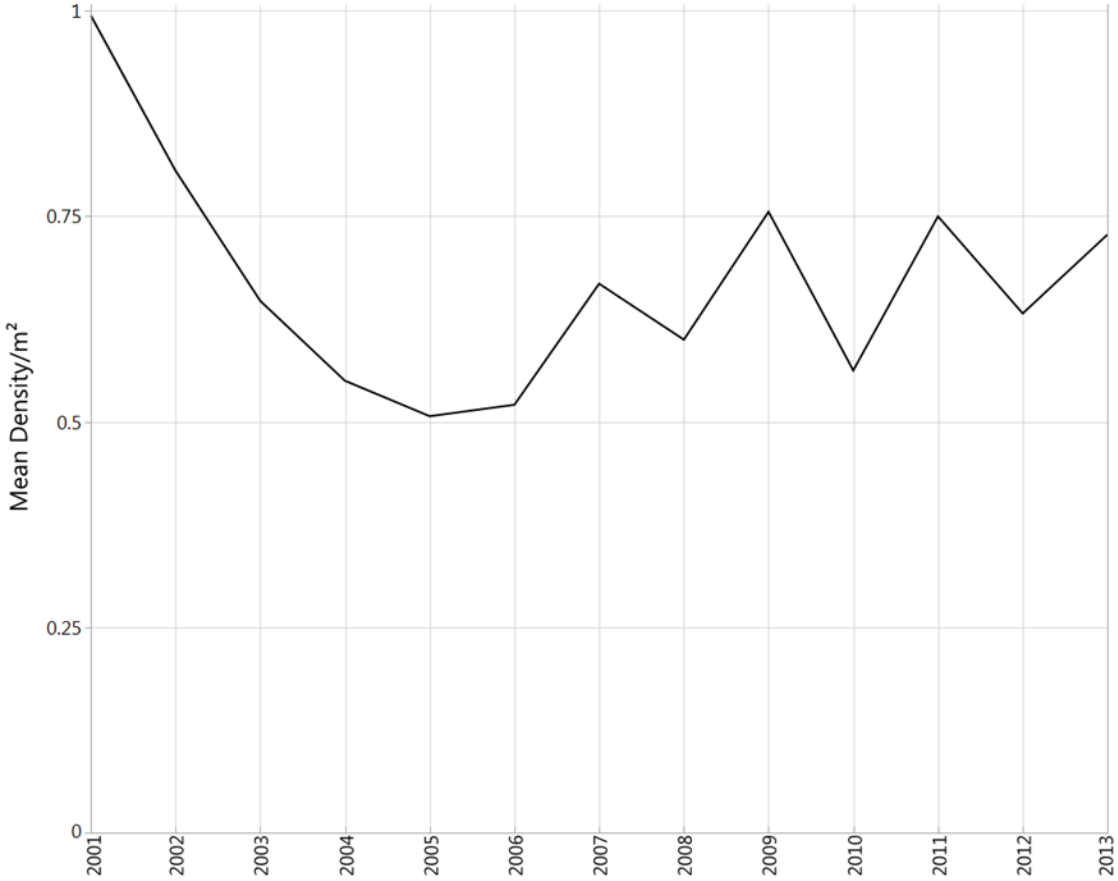


Figure 2. Density of *Haliotis rufescens* at Miracle Mile, San Miguel Island, 2001–2013.

Though Wyckoff Ledge, San Miguel Island had lower densities relative to Miracle Mile, San Miguel Island, the density at this site remained relatively high since we began monitoring it in 1982 and appear to be trending to increasing density since the fishery was closed in 1997. Densities of *H. rufescens* at Santa Rosa Island sites were notably lower than at San Miguel Island and overall remained similar to the past eight years. On Santa Rosa Island, the three sites Chickasaw, South Point, and Johnson's Lee North had higher *H. rufescens* densities compared to the other sites on the Island, similar to past years. We continue to see a few *H. rufescens* on Santa Cruz Island, though they remain rare.

Size frequencies at sites with high abundances of *H. rufescens* show that mean size has steadily been increasing (Miracle Mile, Wyckoff Ledge, Chickasaw, Johnson's Lee North, and South Point). All of

these sites had mean sizes for *H. rufescens* greater than 178 mm consistently for the last three years and were at or at near record high. This is to be expected since the harvesting of *Haliotis* spp. stopped in 1997 with a moratorium on the fishery. Prior to 1997, legal-sized abalones were rare due to high fishing pressure. These data do not necessarily indicate poor recruitment, and increasing abundance suggests there is recruitment occurring that the KFM monitoring protocols are unable to detect.

Since at least 1990, we have conducted very thorough searches for abalone for size frequency measurements to find all that may be present at each site. The exception is Miracle Mile on San Miguel Island where they are too abundant to measure all. This year, as with the past several years, we performed our searches for abalone at the sites where they are common while conducting band transects. As part of the band transect protocol where we searched for abalone, we also searched between each band transect and out to 10 meters using the band transect tape for reference, covering the entire length of the permanent transect and out ten meters on either side to total 2000 m^2. This thorough search allows us to locate all or nearly all abalone present at a site with a consistent search effort. The number of abalone we encountered in this method was similar to recent years. Because we are relatively consistent in our search effort, we believe that the sample size for size frequencies is an additional proxy of density for the sites represented as the number per 2000 m^2. See the natural habitat size frequency table in the workbook on IRMA (Lee 2018) for number of individuals measured per site.

Adult and juvenile *Haliotis* spp. continued to be in low abundances in the ARMs. For the purpose of this report, we consider abalone ≤ 50 mm to be juveniles. Most of the juvenile *H. rufescens* observed this year were in the ARMs at Yellowbanks, Santa Cruz Island, similar to past years. While Yellowbanks continued to have a relatively high abundance (though still low) of *H. rufescens*, it is very far away from any known large adult population of abalone. This suggests it is likely these recruits are coming from a relatively far distance away, such as western Santa Cruz Island, Santa Rosa Island, or San Miguel Island or perhaps there are significant populations of adult abalone we are unaware of. We believe the latter is unlikely since we make regular survey dives and speak with other divers who frequently dive all around Santa Cruz and Anacapa Islands.

Haliotis corrugata continued to be rare or nonexistent at all monitoring sites. This is a warmer water species that even before their decline was rare at Santa Rosa and San Miguel Islands. We observed emergent *H. corrugata* on band transects at two sites (Landing Cove and Cathedral Cove, Anacapa Island), similar to past years, and their abundance continued to be low at these sites. For size frequencies, a total of nine *H. corrugata* were found at four sites. One 122 mm individual was observed at Yellowbanks, Santa Cruz Island. This is the first time that a *H. corrugata* >100 mm has been observed at that site since the 1990s. For ARMs, a total of five *H. corrugata* were found at four sites. In total, *H. corrugata* were observed at five sites. We also found a total of eight fresh *H. corrugata* shells at Admiral's Reef, Anacapa Island, Cathedral Cove, Anacapa Island, Webster's Arch, Santa Barbara Island, Pedro Reef, Santa Cruz Island, Scorpion Anchorage, Santa Cruz Island, and Yellowbanks, Santa Cruz Island, six of which were < 50 mm. These observations imply a low level of *H. corrugata* recruitment has occurred recently, similar to observations in recent years. Several juvenile *H. corrugata* were observed in the ARMs at Santa Cruz Island.

No *Haliotis fulgens* were recorded this year on band transects or found for size frequency measurements. This species like *H. corrugata* prefers warmer water and originally was common at Santa Barbara, Anacapa Islands and Eastern Santa Cruz Island. One fresh shell measuring 32 mm was found at Arch Point, Santa Barbara Island. One small 33 mm *H. fulgens* was found in the ARMs at Cathedral Cove. We only know of one or two adult individual *H. fulgens* on Anacapa and East Santa Cruz Island from recent years and know of no aggregations. It is likely that these smaller abalone recruited from larvae that were transported from further South where *H. fulgens* are more abundant and aggregated.

No live or fresh shells were observed this year for *Haliotis sorenseni* or *Haliotis assimilis.*

Echinodermata

Overall, *Centrostephanus coronatus* remained at low densities, and was most abundant at Anacapa Island sites. It was observed at 20 sites, which included all sites at Santa Cruz, Anacapa, and Santa Barbara Islands, but not at any of the Santa Rosa or San Miguel Island sites. We have observed little change in the abundance of this species in the last 12 years. Juveniles were observed at six sites. *Centrostephanus coronatus* remained in low abundance in the ARMs this year, with observations made at three sites. However, Yellowbanks had a total of 22 juvenile *C. coronatus* which is the most found in the ARMs at any site since 1999. This is a warmer water species and recruitment within the park usually occurs during/after warm water events. We suspect that juveniles found in the ARMs likely recruited during the warm-water event that occurred from August–October 2012.

Lytechinus anamesus densities remained low overall, similar to the past 10 years. This species was more abundant in the 1980s and 1990s compared to the last decade. At Keyhole, Anacapa Island, juveniles were common, and were very cryptic with most covered in debris, large gravel or sand. Many of these were likely missed by the band transect observers, and these could be considered non-emergent which the KFM protocols are not designed to sample. Overall, mean size of *L. anamesus* decreased at KFM sites. The decrease in mean size was due to an increase in juveniles at several Anacapa and Santa Cruz Island sites.

Overall, *Strongylocentrotus franciscanus* abundances increased at Santa Rosa and San Miguel Island sites, remained similar at Santa Cruz, and decreased at Anacapa and Santa Barbara Islands. Density decreased at Southeast Sea Lion Rookery, Santa Barbara Island to a record low for the second consecutive year. Most Santa Barbara Island sites were at or near record low densities. At Anacapa Island, the three sites inside of the MPA remained at low densities. Densities at Cathedral Cove, Anacapa Island and Landing Cove, Anacapa Island remained stable. These later two sites have been designated MPAs since 1978. Admiral's Reef, Anacapa Island density declined for the seventh year in a row.

Strongylocentrotus franciscanus recruitment in the ARMs remained similar to last year. Juvenile *S. franciscanus* are defined in this report as having a test diameter of greater than or equal to 15 mm. Juvenile *S. franciscanus* were common at Santa Cruz, Anacapa, and Santa Barbara Island sites, similar to past years. There was notably more recruitment of *S. franciscanus* at Santa Cruz Island sites compared to sites at the other Islands. Urchin recruitment was not detected in the ARMs at

Santa Barbara Island. This is likely due to the ARMs being new and having very little growth on them rather than a lack of recruitment. These ARMs were installed last year and had very little inside of them except for *Membranipora* sp. bryozoans growing on the bricks. In the past we have suggested the ARMs take about a year to acclimatize before they act more like natural rock substrate.

Strongylocentrotus purpuratus densities decreased at Santa Barbara Island, but remained similar to recent years at the four other islands.

Strongylocentrotus purpuratus recruitment in the ARMs remained similar to last year with moderate densities. Juvenile *S. purpuratus* are defined for this report as having a test diameter of ≤ 15 mm. Juvenile *S. purpuratus* were common at Santa Cruz, Anacapa, and Santa Barbara Islands, similar to past years. However, urchin recruitment was not detected in the ARMs at Santa Barbara Island. This is possibly due to the ARMs being new and having very little growth on them rather than a lack of recruitment. They were installed last year and had very little inside of them except for the bryozoans of *Membranipora* species growing on the bricks.

Sea star densities remained relatively high compared to the 1980s and 1990s. This is likely due to the cold-water regime that the Channel Islands have been experiencing for the last decade. However, there was a decrease in *Patiria miniata* and *Pisaster giganteus* densities at some sites compared to recent years. This is likely due in part to a wasting disease event that followed a significant warm-water event that persisted for approximately one month from August–September 2012 (see temperature graphs in Appendix L, and wasting disease observations in Table 11).

Table 1. Echinoderm wasting disease observations in 2013: species and prevalence (%) of disease at each site. Urchins appearing to have black spot disease were not included in table. Look in site write-up for these observations.

Island	Site	Sea Star Species [a]	Sea Star Observation Date [b]	Sea Urchin Species [a]	Sea Urchin Observation Date [b]
San Miguel	Wyckoff Ledge	None	–	None	–
	Hare Rock	None	–	None	–
	Miracle Mile	None	–	None	–
Santa Rosa	Johnson's Lee North	None	–	None	–
	Johnson's Lee South	None	–	None	–
	Rodes Reef	None	–	None	–
	Cluster Point	None	–	None	–
	Trancion Canyon	None	–	None	–
	Chickasaw	None	–	None	–
	South Point	None	–	None	–
Santa Cruz	Gull Island South	None	–	None	–
	Fry's Harbor	None	–	None	–
	Pelican Bay	None	–	None	–
	Scorpion Anchorage	None	–	2(2%)	08/27
	Yellowbanks	None	–	3(3%)	08/30
	Devil's Peak Member	None	–	6(<1%)	06/10
	Potato Pasture	None	–	2(<1%)	08/28
	Cavern Point	1(1%), 7(1%)	9/18	None	–
	Little Scorpion	None	–	2(1%), 6(3%)	06/14
	Pedro Reef	None	–	2(<1%), 6(<1%)	07/15

[a] Species codes: None = Not observed at this site during our visits in 2013; 1 = Patiria (Asterina) miniata, 2 = Strongylocentrotus purpuratus, 3 = Lytechinus anamesus, 4 = Pisaster giganteus, 5 = Astrometis sertulifera, 6 = Strongylocentrotus franciscanus, 7 = Parastichopus parvimensis, 8 = Dermasterias imbricata, 9 = Mediaster aequalis, 10 = Pycnopodia helianthoides, 11 = Pisaster ochraceus

[b] Date = Date(s) disease/syndrome was observed.

Table 11 (continued). Echinoderm wasting disease observations in 2013: species and prevalence (%) of disease at each site. Urchins appearing to have black spot disease were not included in table. Look in site write-up for these observations.

Island	Site	Sea Star Species [a]	Sea Star Observation Date [b]	Sea Urchin Species [a]	Sea Urchin Observation Date [b]
Anacapa	Admiral's Reef	None	–	6(1%)	08/21
	Cathedral Cove	None	–	None	–
	Landing Cove	None	–	None	–
	Keyhole	None	–	2(<1%), 6(<1%)	06/13
	East Fish Camp	None	–	–	_
	Black Sea Bass Reed	None	–	–	–
	Lighthouse	None	–	2(<1%), 6(<1%)	08/16
Santa Barbara	Southeast Sea Lion Rookery	None	–	2(<1%)	05/14
	Arch Point	None	–	None	–
	Cat Canyon	None	–	6(<1%)	06/12
	Webster's Arch	None	–	None	–
	Graveyard Canyon	None	–	None	–
	Southeast Reef	None	–	None	–

[a] Species codes: None = Not observed at this site during our visits in 2013; 1 = *Patiria (Asterina) miniata*, 2 = *Strongylocentrotus purpuratus*, 3 = *Lytechinus anamesus*, 4 = *Pisaster giganteus*, 5 = *Astrometis sertulifera*, 6 = *Strongylocentrotus franciscanus*, 7 = *Parastichopus parvimensis*, 8 = *Dermasterias imbricata*, 9 = *Mediaster aequalis*, 10 = *Pycnopodia helianthoides*, 11 = *Pisaster ochraceus*

[b] Date = Date(s) disease/syndrome was observed.

Pycnopodia helianthoides are a cooler water species and densities remained relatively high in recent years. The overall high abundance is likely due to the cold-water regime that the Channel Islands have been experiencing for the last decade. *Pycnopodia helianthoides* are one of the most ecologically important invertebrate predators in the kelp forests at the Channel Islands, especially at the cooler water San Miguel, Santa Rosa and Santa Cruz Islands. Their densities increased at San Miguel Island but remained similar at the other islands. *Pycnopodia helianthoides* was observed at 19 sites. At Wyckoff Ledge, San Miguel Island, 14 *P. helianthoides* under 1 cm were counted by one observer on one side of the band transects. However, they were later removed from the datasheet and not entered into the database. This was decided since the average well trained observer typically does not notice this species at that small size. In addition, no *P. helianthoides* that size have ever been recorded in the database or observed at any KFM sites before. Mean size of *P. helianthoides* was notably lower at Wyckoff Ledge, San Miguel Island, Hare Rock, San Miguel Island, Rodes Reed,

Santa Rosa Island, and Yellowbanks, Santa Cruz Island than at all other sites, likely indicating recent recruitment. At Yellowbanks, Santa Cruz Island, all the *P. helianthoides* were noticeably small with none greater than 10 cm. There was little change in *Pycnopodia helianthoides* abundances in the ARMs except for Yellowbanks, Santa Cruz Island, where there was an increase in juveniles.

Patiria miniata densities remained relatively high at the northern islands (San Miguel and Santa Rosa) and continued to gradually increase. However, at the southern islands (Santa Cruz, Anacapa, and Santa Barbara), densities decreased overall. The decrease is likely due to wasting disease (see wasting disease paragraph on proceeding page) following a significant and warm-water event that persisted for approximately one month from August–September 2012 (see temperature graphs in Appendix L). Last year's warm-water event resulted in the highest documented prevalence of sea star wasting disease at eastern KFM sites since the 1997/98 El Niño. The effect of this event on sea star densities did not show up in 2012 data for the majority of KFM sites since most east channel sites had already been sampled in 2012 before the warm-water event occurred. However, densities remain high at eastern site compared to the 1980s and 1990s. This is likely due to the cold-water conditions that the region has been experiencing since the Pacific Decadal Oscillation switched to the negative phase around 1999.

Patiria miniata densities in the ARMs remained at near record-high, similar to last year. However, there was a decrease overall in the ARMS at Santa Cruz Island sites. At Landing Cove, Anacapa Island, the only *P. miniata* found at the entire site were the ones inside the ARMs. None were observed outside of the ARMs at this site.

Pisaster giganteus densities decreased slightly but remained similar to the past decade. Overall, this species is experiencing some of the highest densities recorded at KFM sites since monitoring began in 1982. Similar to *P. miniata* there has not been a large, widespread die-off of *P. giganteus* since the 1997/98 El Niño, which is likely the main reason why *P. giganteus* densities are high compared to years prior when we experienced several die-offs (Eckert et al. 1999). However, in 2012, there was a warm-water event that persisted for approximately one month from August–September. This warm-water event resulted in the highest prevalence of sea star wasting disease at eastern KFM sites that we have documented since the 1997/98 El Niño, and likely attributed to the small decrease in density observed this year. Note that *Pisaster giganteus* densities were collected on both 1 m^2 quadrats and 5 m^2 quadrats. Densities from both sampling protocols are graphed separately (Appendix E and Appendix F).

Pisaster giganteus juvenile (≤ 40 mm) densities in the ARMs were greatest at Anacapa and Santa Cruz Islands. Overall juvenile densities in the ARMs were similar to past years, but there has been a slow gradual decline at Santa Cruz Island over the past four years.

In 2012, KFM began sampling *Pisaster ochraceus* densities on 5 m^2 quadrats. This sea star is an intertidal species, but they have become more prevalent at several KFM sites in recent years. No notable trends were observed for this species.

We continued to observe echinoderm wasting disease (Lafferty and Kushner 1999; Richards and Kushner 1992) at the monitoring sites (Table 11). Sea urchin wasting disease was observed at 11 sites this year, compared to 10 sites in 2012 and 12 sites in 2011. In all cases, the prevalence of the disease was estimated less than 3%, and we did not observe any areas with high mortality.

Ophiothrix spiculata abundance remained at or near record high cover at several Santa Barbara and Anacapa Island sites. However, there were notable decreases at Southeast Sea Lion Rookery and Graveyard Canyon at Santa Barbara Island. This is possibly the result of physical displacement by *Desmarestia* sp. that covered much of the substrate at the site. This low-lying alga, which sweeps back and forth across the substrate due to the swell action, appeared to clear away *O. spiculata* directly adjacent where these algae were present. *Ophiothrix spiculata* was moderately abundant at Pedro Reef, Santa Cruz Island on the offshore side of the transect but this was not shown in the RPC data too well because most were more than a meter off the transect. Similarly, *O. spiculata* was more abundant at Lighthouse, Anacapa Island, on the offshore side of the transect, than the RPCs indicated. Cover remains low at Santa Cruz, Santa Rosa, and San Miguel Islands, although it increased at Gull Island, Santa Cruz Island for the third year in a row. Overall, *O. spiculata* cover continued to increase at Anacapa Island, but decreased slightly at Santa Barbara Island.

Parastichopus parvimensis densities continued to be higher at sites inside the Santa Cruz, Santa Rosa, and Anacapa Island MPAs than outside**.** However, at Santa Barbara Island densities are similar inside and outside the MPA, similar to past years. At San Miguel and Santa Rosa Island sites, *P. parvimensis* were relatively rare and notably large, which is what we normally observe for these islands. Santa Cruz and Anacapa Islands continued to have high abundances of this species overall, but remained lower than pre-fishery abundances.

Pachythyone rubra cover changed little this year. Cover of *P. rubra* at Santa Cruz Island remained low compared to the 1990s and remained rare at all but one of the monitoring sites, Potato Pasture, Santa Cruz Island. At Potato Pasture, percent cover increased to the highest recorded at this site (8.0 %). At Fry's Harbor, Santa Cruz Island, where *P. rubra* were abundant in the 1990s and early 2000s, there was a high-density patch inshore of the zero end of the transect, which did not get picked up by the RPC protocol since it was further than a meter off the main transect. Otherwise *P. rubra* were rare at the site. Inshore of Pelican Bay, Santa Cruz Island, *P. rubra* were common inshore of the transect area at 2–3 m depth. At Trancion Canyon, Santa Rosa Island, *P. rubra* were common, but patchy and mostly aggregated in a single area at the site.

Tunicates

Overall, tunicate cover increased. The greatest increases occurred at San Miguel and Santa Rosa Island sites, although tunicates increased at Santa Cruz, Anacapa, and Santa Barbara Island sites as well. Miracle Mile, San Miguel Island, South Point, Santa Rosa Island, Devil's Peak Member, Santa Cruz Island, and Southeast Reef, Santa Barbara Island had the highest covers ever recorded for these sites. *Styela montereyensis* remained common at Santa Rosa Island and San Miguel Island sites, though continued to decrease overall at these islands. Most of the declines occurred at Johnson's Lee North and Johnson's Lee South, Santa Rosa Island. At sites where *S. montereyensis* were common, all sizes were present. At sites where rare, only small individuals were observed.

Fish

Coryphopterus nicholsii densities remained similar to last year. *Alloclinus holderi* densities remained relatively low, continuing a trend of decreasing density since 2003. This is a warmer water species and what we would expect from the past ten years of relatively cooler water temperatures. All sites had little to no change in *A. holderi* density this year. *Lythrypnus dalli* abundances remained low at all sites, similar to last year. This is a warm water species and experiences increases in abundance during warm water events, such as an El Niño. Proceeding El Niño events, their abundance typically tapers off over the next year or two. The last El Niño occurred in 2009 and was a weak one. This El Niño was likely responsible for creating only some patchy localized recruitment. We observed a high abundance of *Oxylebius pictus* recruits at Lighthouse, Anacapa Island, East Fish Camp, Anacapa Island, and Little Scorpion, Santa Cruz Island.

Male *Semicossyphus pulcher* abundance increased over recent years at Anacapa, Santa Cruz, Santa Rosa, and San Miguel Island sites. There was little change in abundance compared to recent years at Santa Barbara Island. Female abundances increased at Santa Barbara and Anacapa Islands following two years of declines. Abundance continued to decline at Santa Cruz Island, with little change occurring at the remaining islands when compared to the last five years. Juvenile *S. pulcher* abundances remained low similar to the last three years. At Pelican Bay, Santa Cruz Island, one male estimated at 115 cm was observed. Several divers commented that this was the largest sheephead that they had ever seen and there was agreement on its size estimate.

Adult *Oxyjulis californica* increased in abundance following three years of decreases. The greatest increase was at Santa Barbara Island sites. There was little overall change at the three northernmost islands. There was little change in abundances of juvenile *O. californica* compared to recent years. Last year's recruits of *Oxyjulis californica* were observed in a school at Cat Canyon, Santa Barbara Island and were recorded on RDFC since they were <10 cm as per our juvenile definition. *Oxyjulis californica* YOY were observed at Pedro Reef, Santa Cruz Island.

Male, female, and juvenile *Halichoeres semicinctus* abundances remained low, similar to the last five years. This is another warm water species that tends to recruit more during warmer years. Note that the visual fish transects combine juveniles into the female category.

Adult *Chromis punctipinnis* abundance increased from last year and distribution changed little. The greatest increases occurred at Santa Barbara Island sites. Juvenile *Chromis punctipinnis* abundances changed little from recent years. Skin ulcers, likely caused by *Vibrio damsela*, a marine bacterium, were observed on several *Chromis punctipinnis* at Anacapa Island's Admiral's Reef. These skins ulcers are usually observed on a few *C. punctipinnis* at this site, especially during or after persistent warm water events. At Webster's Arch, Santa Barbara Island, small *C. punctipinnis* were moderately abundant, likely from last year's recruitment but still had the characteristic yellow tail of a juvenile. At Rodes Reed, Santa Rosa Island, ten very small *C. punctipinnis* YOY were observed, these were still partially translucent.

Hypsypops rubicundus adult abundance was similar to past years, while juvenile *H. rubicundus* continued to be rare. At Cathedral Cove, Anacapa Island, at least six juvenile *H. rubicundus* were

observed on 10/22, a day on which RDFCs were not conducted. This was one of the highest numbers of juveniles observed at a site this year. At Landing Cove, Anacapa Island, four juvenile *H. rubicundus* were observed, though only three during RDFCs, and were likely recruits from this year.

Adult *Paralabrax clathratus* abundance increased overall from recent years. The highest abundance continues to be at Black Seabass Reef, Anacapa Island. That site also experienced the greatest increase in abundance from last year. The remaining sites changed little compared to recent years. Juvenile *P. clathratus* increased at the majority of Anacapa and Santa Cruz Island sites compared to recent years. It should be noted that our fish counts are often completed at many sites before juvenile *P. clathratus* recruit, which typically happens in late summer or early fall. At Arch Point, Santa Barbara Island, there were at least 12 small *Paralabrax clathratus,* ranging from 8–12 cm in size. These were placed in the RDFC juvenile category since they were most likely last year's recruits. We typically miss *P. clathratus* recruitment at Santa Barbara Island due to the timing of our sampling season which begins in early May and we typically start monitoring this island first. If these were not counted as juveniles, we would be missing these recruitment events in the data. On August 28th at Potato Pasture, Santa Cruz Island, we observed the first *P. clathratus* recruits of the year. At Keyhole, Anacapa Island, recruits (9–13 cm) from last year were common, and we observed a large aggregation of over 60 *P. clathratus* (all large than 35 cm) inshore of the transect.

Adult *Embiotoca jacksoni* abundances at Santa Cruz Island remained high compared to 2003–2010, similar to the last two years. Abundances decline for the third consecutive year at Santa Rosa Island, and there was little change at Santa Barbara, Anacapa, and San Miguel Islands. Juvenile *E. jacksoni* changed little in abundance from last year. The greatest changes occurred at Fry's harbor, Santa Cruz Island, which decreased in abundance, and Cavern Point, Santa Cruz Island, which increased.

Adult *Embiotoca lateralis* abundance increased at all three San Miguel Island sites and remained similar to recent years at the remaining four park islands. Juvenile *E. lateralis* abundances remained similar to the last four years at Santa Rosa and San Miguel Island sites. Few juveniles were observed at sites from the remaining three park islands. Little change was observed in adult and juvenile *Rhacochilus vacca*. At Hare Rock, San Miguel Island, after RDFCs were conducted, one large *Rhacochilus vacca* was observed. *Girella nigricans* abundances remained similar to recent years. Note that juveniles are not graphed since they are found in intertidal tide pools and not kelp forests.

Sebastes spp. remained relatively abundant and diverse this year, similar to the last two years. Overall, there continued to be relatively high recruitment of most species common to KFM sites, and a record number of *Sebastes* spp. juveniles recorded at Santa Barbara Island. Many could not be properly identified. See section on *Sebastes* spp. below, as well as Santa Barbara Island site notes, for more information.

Adult and juvenile *Sebastes mystinus* increased in abundance from recent years. Adults increased at Santa Rosa Island while juveniles increased across all five park islands. Adult *Sebastes serranoides* increased to some of the highest recorded densities at several Santa Rosa Island sites, while remaining similar to past years at the other four park islands. Juvenile *S. serranoides* increased at all five park islands. Many KFM sites had the highest recorded densities in at least a decade. Adult and

juvenile *Sebastes serriceps* abundances remained similar to recent years. Adult *Sebastes atrovirens* abundances continued to increase at San Miguel Island overall for the third consecutive year. Abundances remained high at Santa Rosa Island sites relative to 2005–2011. There was little change at the remaining three park islands. This year, Kelp/Gopher/Copper/Black and Yellow Rockfish Complex young of the year (KGB) increased dramatically at Santa Barbara Island sites, decreased at Anacapa Island, and changed little at the remaining three park islands.

Adult *Sebastes paucispinis,* bocaccio, were not observed this year, similar to recent years but this is typical since adults tend to move offshore into deeper water. Juvenile *S. paucispinis* were observed at 10 sites, an increase from recent years. Juvenile *S. caurinus,* copper rockfish, experienced a decrease from the last three years. While adult abundances of this species were similar to recent years. Adult *S. miniatus,* vermillion rockfish, remained rare, similar to previous years, with observations at three sites. There was a record number of juvenile *S. miniatus* present at Santa Barbara this year. Many other juvenile rockfish were present. The majority could not be positively identified but were believed to be a combination of *S. mystinus*, *S. serranoides*, and *S. entomelas*. All of the unidentified fish had elongate bodies, and most had a black dorsal spot. All had mottling, but the mottling differed between two different forms. One form was similar to juvenile blue coloring but faded. The other form looked like it was filling in and forming larger blotches. The KGB juveniles were also common at the site. At Gull Island, Santa Cruz Island, *Sebastes atrovirens*, *S. chrysomelas*, *S. carnatus* and *S. serriceps* were all notably more active, visible and out of the crevices in the evening. Adult *S. chrysomelas*, black and yellow rockfish, and adult *S. carnatus*, gopher rockfish, abundances were similar to recent years. Adult *S. auriculatus*, brown rockfish, abundances were similar to recent years and were observed at five sites. Juvenile *S. auriculatus* were not observed this year, similar to last year. Adult *S. melanops*, black rockfish, were observed at four sites, an increase from recent years. Adult *S. rastrelliger,* grass rockfish, abundances were similar to recent years, and were observed at seven sites. One juvenile *S. semicinctus*, halfbanded rockfish, was observed at one site. This species is rarely seen at KFM sites and is typicaly found at depths deeper than the sites. Juvenile *S. pinniger*, canary rockfish were observed at two sites. One juvenile *S. saxicola*, stripetail rockfish, was observed.

Adult *Ophiodon elongatus,* lingcod, were observed at 13 sites, similar to recent years. Adult *Scorpaenichthys marmoratus*, cabezon, were observed at 21 sites. Juveniles were observed at six sites with a mean of 1/site. At least five juvenile *S. marmoratus* at about 7 cm were observed at Fry's Harbor, Santa Cruz Island. The coloration on these individuals was dull. More were observed at other Santa Barbara Island sites. Adult *Caulolatilus princeps*, ocean whitefish, were observed at 10 sites, similar to last year. One adult *Stereolepis gigas,* giant black sea bass, was observed at one site, similar to past years. However, additional *S. gigas* were observed at several other sites after the fish counts were conducted. At Black Seabass Reef, Anacapa Island, four small adults were observed on August 16th. Similarly, on August 16th, two large *S. gigas* were observed at Lighthouse, Anacapa Island. During a survey dive between Moore Meadows and Blue Banks, Santa Cruz Island on August 27th, one small adult *S. gigas* was observed.

One *Squatina californica*, Pacific angel shark, was observed this year during the fish counts at two sites, similar to past years, and these continue to be more common in recent years.

Artificial Recruitment Modules (ARMs)

ARMs were monitored at all 12 sites where they were present. In 2012, three ARMs were installed at Santa Barbara Island at Southeast Reef. This is the first year that data were collected from them. These were the only ARMs at this island due to its high exposure to south swell. Past attempts to install ARMs at this site have failed and these three ARMs were bolted to the substrate in hopes of preventing them from being damaged or destroyed by movement. If these three ARMs survive several years, more may be deployed at this island. Other than the bricks being covered with encrusting bryozoans, *Membranipora* sp., there were few indicator species or any species in these ARMs.

In addition to the information below, a description of ARMs recruitment data can be found in the discussion section for each monitored species.

At Cathedral Cove, Anacapa Island, ARM #2346 was missing four bricks (one layer) and we considered not using the data from that ARM. However, we all agreed that it is no different than a layer of bricks covered by silt or sand, which occurs regularly. In addition, the data was similar to the other ARMs sampled at the site, so it was decided by consensus that these data were worthy of keeping.

At Johnson's Lee North, several bricks were replaced at the two ARMs at the north end group.

At Johnson's Lee South, Santa Rosa Island, the ARMs were in good condition and did not move during the winter season. One *Brosmophycis marginata*, red brotula, and one *Nautichthys oculofasciatus*, sailfin sculpin, were observed in the ARMs.

At Pelican Bay, Santa Cruz Island, ARM cages #2312, 2317 and 2316 were replaced. Barnacles covered the bricks at this site.

At Yellowbanks, Santa Cruz Island, 10 ARMs were sampled for all indicator species and five ARMs were sampled for all indicator species except for *Strongylocentrotus franciscanus* and *S. purpuratus*. The latter were not sampled for these sea urchins due to their extreme abundance. This information is kept track of in the dataset. At least seven small *Orthasterias* sp. were observed in the ARMs.

At Miracle Mile, San Miguel Island, ARM #2471 was on its side, but was still able to be sampled. One ARM and three lids were replaced. ARM #2473 was changed to #2483 due to a missing tag/lid.

Invasive Species

Refer to the algae section of the discussion for information on the invasive indicator species *Sargassum horneri.*

The non-native bryozoan *Watersipora subtorquata* was observed in 2011 for the first time at KFM sites. No notes were taken this year on this species.

Temperature

Two Tidbit® temperature loggers were deployed at every site except for Miracle Mile, which has no temperature logger stake because of the site's close proximity to the Wyckoff Ledge site. Hourly temperature data were successfully retrieved from all 32 sites. The data were downloaded from the temperature loggers beginning in middle of summer; therefore, we look at annual water temperatures from May 2012 to April 2013. Refer to Appendix L for annual temperature data graphs.

The region experienced a warm-water event from August–October in 2012. The mean monthly temperature for all sites for October was the highest recorded since 1997 during one of the strongest ENSO events documented. San Miguel and Santa Rosa Islands continued to experience the highest monthly mean temperature recorded for November since 1997.

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Appendix A. Protocol Modifications, Data Management, Database Corrections, and Additional Projects Information

Protocol Changes
No protocol changes were made this year.

Sampling Difficulties
All proposed data collection was completed this year.

Database changes/corrections
Data for six quadrats for Miracle Mile, San Miguel Island 2001 were deleted from database. Only 6 were completed instead of the full 12. The half sample was deleted since they are not comparable to other years or sites. The data sheet remains archived with other Miracle Mile, San Miguel Island datasheets.

Several corrections were made to data in the database this year. In preparation for a program review, outliers in the data set were examined. Several were determined to be from observer error due to inexperience, and several were data entry errors.

Table A-1. Database changes.

Date Changed	Survey Date	Protocol	Island Code	Site Code	Spp#	Scientific Name	quadrat/ band #	Changed from	Changed to	Justification
11/20/2013	7/7/1986	band transects	SM	HR	9004	*Haliotis fulgens*	10	1	0	Most likely an identification error. The individual was less than 40 mm. This spp is a warmer water spp. not found at SMI.
11/20/2013	7/13/2006	natural habitat size frequency	SR	TC	9009	*Megathura crenulata*	n/a	134	null	outliers, incorrectly measured by inexperienced observer
11/20/2013	7/13/2006	natural habitat size frequency	SR	TC	9009	*Megathura crenulata*	n/a	141	null	outliers, incorrectly measured by inexperienced observer
11/20/2013	7/13/2006	natural habitat size frequency	SR	TC	9009	*Megathura crenulata*	n/a	144	null	outliers, incorrectly measured by inexperienced observer
11/20/2013	7/13/2006	natural habitat size frequency	SR	TC	9009	*Megathura crenulata*	n/a	144	null	outliers, incorrectly measured by inexperienced observer
11/20/2013	7/13/2006	natural habitat size frequency	SR	TC	9009	*Megathura crenulata*	n/a	146	null	outliers, incorrectly measured by inexperienced observer
11/20/2013	7/13/2006	natural habitat size frequency	SR	TC	9009	*Megathura crenulata*	n/a	155	null	outliers, incorrectly measured by inexperienced observer
11/20/2013	7/13/2006	natural habitat size frequency	SR	TC	9009	*Megathura crenulata*	n/a	162	null	outliers, incorrectly measured by inexperienced observer

Table A-1 (continued). Database changes.

Date Changed	Survey Date	Protocol	Island Code	Site Code	Spp#	Scientific Name	quadrat/ band #	Changed from	Changed to	Justification
11/20/2013	7/13/2006	natural habitat size frequency	SR	TC	9009	*Megathura crenulata*	n/a	187	null	outliers, incorrectly measured by inexperienced observer
11/20/2013	7/30/2004	natural habitat size frequency	SC	YB	11001	*Patiria/Asterina miniata*	n/a	22 individuals at 23 mm	1 at 22 mm, 1 at 23 mm	data entry error
11/20/2013	8/21/2002	natural habitat size frequency	SC	GI	9009	*Megathura crenulata*	n/a	186	null	outlier exceeding maximum size for this sp., observer error
11/20/2013	8/9/1995	natural habitat size frequency	SC	PB	11005	*Strongylocentrotus franciscanus*	n/a	spp#11005 @ 51mm, 63 mm, 105 mm, 134 mm, 184 mm	spp#11002 @ 51mm, 63 mm, 105 mm, 134 mm, 184 mm	data entry error
11/20/2013	9/12/2011	band transects	SR	RR	2016	*Sargassum horneri* adult	4	1	0	data entry error

Appendix B. KFM Program Data Usage and Information Requests for 2013

Publications

The following scientific paper using KFM data were published in 2013:
Goddard J. H. R., M. C. Schaefer, C. Hoover, and A. Valdes. 2013. Regional extinction of a conspicuous dorid nudibranch (Mollusca: Gastropoda) in California. Marine Biology 160(6):1497–1510.

Data Requests

There were six formal data requests from outside NPS. All requests were fulfilled.

Lindsay Marks, graduate student from UCSB, was sent all temperature and *Sargassum horneri* data to be used for a Western Society of Naturalists Symposium poster as well as other work she is performing which involves keeping track of where *S. horneri* has been documented by various monitoring programs in California.

Carlos Mireles from CDFW was sent all past years *Parastichopus parvimensis* size frequency and ARM data.

Erica Jarvis from CDFW was sent *Paralabrax clathratus* data for visual fish transects and fish size frequencies.

Christiane Elfes, graduate student from UCSB, was examining the redistribution of fishing effort in response to MPA designations, and was sent the following: 1m quadrat raw and summary data 1996–2012, 5m quadrat raw and summary data 1996–2012, fish size frequency raw and summary data 2007–2012, macrocystis size freq data all, RPC raw and summary data 1982–2012, RDFC raw and summary data 1996–2012, fish transect raw and summary data 1985–2012.

Nick Shears from the University of Auckland was sent *Parastichopus parvimensis* data for 1m quadrats as well as *P. parvimensis* data collected from additional late fall 5 m quadrats surveys. He is examining differences in abundances inside versus outside of Channel Islands MPAs.

William Pikini from CSU Chico was sent all KFM density data, and 15 cm resolution benthic maps of KFM sites to quantify species habitat associations using long-term data.

Information Requests

The kelp forest monitoring handbooks and annual reports are available in PDF format on the web at: https://www.nps.gov/im/medn/kelp-forest-communities.htm

To obtain raw data collected by the Kelp Forest Monitoring Program, please contact Joshua_Sprague@nps.gov or David_Kushner@nps.gov, or write to:

Superintendent, Channel Islands National Park, 1901 Spinnaker Drive,Ventura, CA 93001

Appendix C. Species List

Introduction

The species list contains presence/absence and relative abundance data for all indicator species that could be found and identified during the site visits between May and November. The overall effort varies from site to site with the water conditions and available time. Relative abundance values are subjective, and generally based on opinions of several divers viewing the overall site. When identification is tentative, we coded it as an unknown.

Abundance Ratings

- X present, no relative abundance rating given
- 4 abundant, organism present in higher than normal densities
- 3 common, organism found over most of site or in high density patches
- 2 present, organism found in moderate numbers
- 1 rare, few organisms found
- 0 noticeably absent, an effort was made to look for an organism that was not found.
- — unknown

Notes

j – juvenile
s – shell only
#/J# – (e.g. 2/J3 – adult abundance 2, juvenile abundance 3)

Table C-1. Sites #1–16.

Taxon	Species	SMWL 1	SMHR 2	SRJLNO 3	SRJLSO 4	SRRR 5	SCGI 6	SCFH 7	SCPB 8	SCSA 9	SCYB 10	ANAR 11	ANCC 12	ANLC 13	SBSESL 14	SBAP 15	SBCAT 16
CHLORO-PHYTA	*Bryopsis* spp.	–	–	–	–	–	–	–	–	–	–	–	–	–	0	–	–
	Cladophora spp.	–	–	–	–	–	–	X	–	–	–	X	–	–	X	–	–
	Codium spp	–	–	–	–	–	–	X	1	–	–	1	–	2	0	–	1
	Derbesia spp.	–	–	–	–	–	–	X	–	–	–	–	X	–	1	–	–
	Enteromorpha spp.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Ulva spp.	–	2	–	–	–	–	–	–	–	–	–	X	–	X	–	–
	Other green algae	–	2	–	–	–	1	1	1	–	–	1	1	1	X	1	1
PHAEO-PHYTA	*Agarum fimbriatum*	0	0	0	–	–	2/j2	0	–	0	0	0	0	0	0	0	0
	Colpomenia spp.	–	0	1	–	–	1	X	–	2	1	1	X	X	0	–	–
	Cystoseira spp.	2	0	1	1	0	1	0	0	0	1/j2	0/j1	3	2	0	1	2
	Desmarestia spp.	2/j1	1/j1	1	1	2	1	1	1	0	1	1	3	1	2	1	2
	Dictyoneuropsis	–	0	0	2	–	0	0	–	0	0	–	–	0	0	–	–
	Dictyota/Pachydictyon	–	0	–	–	0	X	X	0	2	X	1	2	4	1	1	2
	Eisenia arborea	1	1/j0	2	2/j2	0	2/j2	3/j2	0	0/j1	1/j1	0/j2	2/j2	4/j4	0/j1	1/j1	1/j1
	Laminaria farlowii	1	0	2	2/j2	0/j1	0/j0	0	0	0/j1	1/j1	0	3/j4	4/j4	0	0	0
	Macrocystis pyrifera	3/j1	2/j0	3/j2	3/j2	1/j1	2/j2	3/j2	0	1/j1	3/j2	1/j1	4/j4	2/j2	1/j1	1/j1	2/j2
	Pterygophora californica	3/j1	0	2	1	0	0/j1	0	0	0	2/j2	0	0	3/j2	0	0	0
	Sargassum muticum	0	0	1	0	0	0	0	0	2	0	0	2	0	0	1	1
	Sargassum horneri	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
	Other brown algae	–	–	2	2	1	–	–	–	2	2	1	2	X	X	1	2

Table C-1 (continued). Sites #1–16.

Taxon	Species	SMWL 1	SMHR 2	SRJLNO 3	SRJLSO 4	SRRR 5	SCGI 6	SCFH 7	SCPB 8	SCSA 9	SCYB 10	ANAR 11	ANCC 12	ANLC 13	SBSESL 14	SBAP 15	SBCAT 16
RHODO-PHYTA	*Callophyllis* spp.	X	–	–	–	–	–	–	–	0	–	–	–	–	–	–	–
	Cryptopleura spp.	–	–	–	–	–	–	–	–	0	–	–	–	–	X	–	–
	Fauchea spp.	–	–	–	–	–	–	–	–	0	–	–	X	–	X	–	–
	Gelidium spp.	0	0	1	–	0	–	–	0	0	0	0	2	3	0	–	1
	Gigartina spp.	0	0	2	2	0	X	2	0	1	0	0	–	2	1	0	0
	Laurencia spp.	–	2	–	–	–	X	X	1	1	X	2	X	–	2	1	2
	Mazzaella spp.	–	–	–	–	–	–	–	–	0	–	–	–	–	–	–	0
	Membranoptera spp.	–	–	–	–	–	–	–	–	0	–	–	–	–	–	–	–
	Microcladia spp.	–	–	–	–	–	–	–	–	0	–	–	–	–	0	–	–
	Plocamium spp.	–	–	0	–	–	–	–	–	0	–	0	–	–	0	–	–
	Polyneura spp.	–	–	–	–	–	–	–	–	0	–	–	–	–	0	–	–
	Rhodymenia spp.	X	–	3	X	–	X	X	–	–	X	X	X	–	–	–	–
	Articulated coralline	2	1	2	2	1	2	1	1	1	2	1	–	2	1	1	1
	Encrusting Coralline	2	4	2	2	4	2	2	2	4	3	4	–	2	4	4	4
	Other red algae	2	2	4	3	2	3	3	1	1	2	1	3	2	2	1	2
	Misc. Plant (diatom film or *Phyllospadix* spp.)	2	1	2	2	1	–	1	1	2	1	2	1	–	2	1	1

Table C-1 (continued). Sites #1–16.

Taxon	Species	SMWL 1	SMHR 2	SRJLNO 3	SRJLSO 4	SRRR 5	SCGI 6	SCFH 7	SCPB 8	SCSA 9	SCYB 10	ANAR 11	ANCC 12	ANLC 13	SBSESL 14	SBAP 15	SBCAT 16
PORIFERA	*Haliclona* sp.	2	–	–	3	–	–	–	–	–	–	–	–	–	–	–	–
	Hymenamphiastra (Acanthancora) cyanocrypta	–	–	–	X	–	–	–	–	–	–	–	–	X	–	–	–
	Leucetta losangelensis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Polymastia pacifica	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
	Tethya aurantia	2	2	4	3	3	4	3	2	2	3	2	1	x	2	1	1
	Other sponges	2	2	3	3	2	3	2	2	1	2	2	2	2	2	1	1
ANTHOZOA	*Anthopleura elegantissima*	2	–	2	X	X	–	–	1	2	1	–	–	2	–	–	1
	Anthopleura xanthogrammica	–	X	–	–	–	–	–	–	–	–	–	X	–	–	2	–
	Astrangia lajollaensis	2	2	2	2	3	X	4	3	2	3	2	1	2	1	2	1
	Balanophyllia elegans	2	2	2	2	2	X	1	2	2	2	1	1	1	1	1	1
	Clavularia spp.	–	–	–	–	–	–	–	X	X	–	–	–	X	–	–	–
	Corynactis californica	2	3	2	2	2	2	2	2	2	2	3	2	3	2	3	1
	Lophogorgia chilensis	0	0	1	2	0	2	3	2	1	2	2	0	1	2	1	1
	Metridium spp.	0	1	0	–	0	–	0	0	0	0	–	–	0	0	0	0
	Muricea californica	0	0	0	0	0	–	0	0	0	1	2	0	1	2	1	1
	Muricea fruticosa	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1
	Parazoanthus lucificum	–	–	X	X	–	–	–	–	0	–	1	–	X	–	0	–
	Urticina lofotensis	4	2	2	2	2	–	0	0	0	0	0	0	0	0	0	0

Table C-1 (continued). Sites #1–16.

Taxon	Species	SMWL 1	SMHR 2	SRJLNO 3	SRJLSO 4	SRRR 5	SCGI 6	SCFH 7	SCPB 8	SCSA 9	SCYB 10	ANAR 11	ANCC 12	ANLC 13	SBSESL 14	SBAP 15	SBCAT 16
HYDROZOA	Hydroids	–	–	–	3	–	3	–	–	1	–	–	–	–	–	–	–
	Aglaophenia struthionides	–	–	X	3	–	–	–	–	–	–	0	–	X	0	–	–
	Hydractinia milleri	–	–	–	–	–	–	2	–	–	–	–	X	–	–	X	–
	Plumularia spp.	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
	Stylaster californicus	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
ANNELIDA	*Diopatra ornata*	2	1	2	3	2	3	3	1	1	1	1	2	2	1	1	2
	Dodecaceria fewkesi	1	2	–	–	2	X	0	2	1	–	–	–	–	–	1	1
	Phragmatopoma californica	1	1	2	1	0	0	0	0	0	0	0	–	2	0	1	3
	Salmacina tribranchiata	0	0	X	–	–	2	X	1	0	1	1	X	X	–	1	1
	Spirobranchus spinosus	0	–	1	–	–	1	1	1	2	1	2	2	2	2	2	2
ARTHRO-PODA/ Crustacea	*Balanus* spp.	4	3	X	3	4	X	X	3	2	2	–	X	1	1	3	2
	Cancer spp.	2	2	1	2	1	2	X	1	1	M	1	–	0	1	1	1
	Panulirus interruptus	0	0	0m	0	1	1	0	1	2	1	1	3	3	1	1	2
BRYZOA	*Bugula californica*	–	–	3	2	–	X	3	1	–	2	2	3	2	–	1	1
	Costazia costazi	–	X	X	2	X	X	2	–	X	X	–	–	–	0	0	–
	Diaperoecia (Diaperoforma) californica	1	1	2	2	2	3	2	1	1	1	2	2	2	1	1	1
	Other bryozoans	2	1	3	3	2	2	4	1	1	2	1	3	3	1	1	2
TUNICATES	Tunicate	x	1	4	2	2	2	1	1	1	2	1	3	0	1	1	3
	Styela montereyensis	1	1	2	2	1	X	0	0	0	1	0	0	3	0	0	0
	Misc. Invertebrate	–	3	3	–	2	–	3	3	1	2	2	3	–	2	2	3

Table C-1 (continued). Sites #1–16.

Taxon	Species	SMWL 1	SMHR 2	SRJLNO 3	SRJLSO 4	SRRR 5	SCGI 6	SCFH 7	SCPB 8	SCSA 9	SCYB 10	ANAR 11	ANCC 12	ANLC 13	SBSESL 14	SBAP 15	SBCAT 16
MOLLUSCA	*Aplysia californica*	1	2/j3	1	1	1	2	2	1	2	1	1	1	0	1	3	3
	Crassedoma gigantea	2	1	2	1	1	1	2	1	2	1	1	3	3	1	1	2
	Cryptochiton stelleri	1	0	0	1	0	–	0	0	0	0	0	0	0	0	0	0
	Cypraea spadicea	1	3	2	2	2	2	3	1	1	1	1	2	2	1	1	2
	Haliotis assimilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Haliotis corrugata	0	0	0	0	0	1	S	0	S	1	S	1	1	0	0	1
	Haliotis fulgens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	S	0
	Haliotis rufescens	3/j0	S	2	1	0	S	S	1	0/s	1	0	1	0	0	0	0
	Haliotis sorenseni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Kelletia kelletii	4	1/j1	0	2	2/j1	1	2	2/j3	1	2	2	0	1/j1	0	0	0
	Lithopoma gibberosa	3	2/j0	0	0	3	X	0	0	0	3/j2	0	0	0	0	1	1
	Megastraea undosa	0	0	1	0	0	2	0	1	1	3/j3	1	2/j2	3/j0	1	2/j2	2
	Megathura crenulata	1	1	2	1	1	2	2	1	2	2	3	1	1	1	1	1
	Octopus spp.	1	–	2	X	1	X	X	1	X	2	–	–	X	1	1	1
	Serpulorbis squamigerus	1	2	2	2	1	X	2	2	2	2	1	2	2	1	1	2
	Tegula regina	0	0	0	0	2	1	1	1	1	1	2	2	1	2	3	3

Table C-1 (continued). Sites #1–16.

Taxon	Species	SMWL 1	SMHR 2	SRJLNO 3	SRJLSO 4	SRRR 5	SCGI 6	SCFH 7	SCPB 8	SCSA 9	SCYB 10	ANAR 11	ANCC 12	ANLC 13	SBSESL 14	SBAP 15	SBCAT 16
ECHINO-DERMATA	*Centrostephanus coronatus*	0	0	0	0	0	0	–	?	2/j1	1/j1	2	2	2	1	2	1
	Cucumaria spp.	2	–	3	3	2	2	3	2	2	2	2	X	3	X	X	X
	Dermasterias imbricata	2	0	2	3	2	0	2	0	0	0	0	0	0	0	0	0
	Henricia spp.	–	3	2	2	2	X	X	1	–	2	2	–	–	1	0	–
	Lytechinus anamesus	0	0	0	0	0	1	0	2	1	3	0	1	0	0	2	0
	Ophiothrix spiculata	1	1	1	1	1	3	1	1	1	2	4	1	1	4	2	1
	Pachythyone rubra	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0
	Parastichopus californicus	1	0	0	1	0	2	1	0	0	0	0	0	1	0	0	0
	Parastichopus parvimensis	1	1	1	2	1	2	1	1	3	1	2	3	3	2	2	2
	Patiria miniata	3	4	4	4	4	3	2	3	2	2	3	1	1	2	2	1
	Pisaster giganteus	3	3/j1	2	3	3	2	3	2	2	2	2	1	1	1	2	2
	Pisaster ochraceus	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	1
	Pycnopodia helianthoides	1/j2	3/j3	4	2	3/j3	2	2	1	0	0/j3	0	0	0	0	0	0
	S. purpuratus	2/j1	2/j2	2/j1	2/j1	1	3/j1	2/j1	3/j1	4/j1	2/j3	2/j2	2	2/j1	2/j1	4	3/j1
	S. francsicanus	2/j1	4/j2	3/j1	2/j1	3/j1	3/j1	2/j1	2/j1	2/j1	3/j2	3/j1	3	2/j1	1/j0	3	2
FISH	*Lythrypnus dalli*	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0	0
	Coryphopterus (Rhinogobiops) nicholsii	1	2	2	2	1	2	2	4	3	3	4	2	2	4	2	2
	Alloclinus holderi	0	0	0	0	0	1	1	0	0	0	1	0	1	0	1	1

Table C-2. Sites #21–37.

Taxon	Species	SMMM 21	SRCP 22	SRTC 23	SRCSAW 24	SRSP 25	SCDPM 26	SCPP 27	SCCVP 28	SCLS 29	SCPRF 30	ANKH 31	ANEFC 32	ANBSBR 33	ANLH 34	SBWA 35	SBGC 36	SBSER 37
CHLORO-PHYTA	*Bryopsis* spp.	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–
	Cladophora spp.	–	–	–	–	–	–	–	–	–	1	–	–	2	–	–	–	–
	Codium spp	–	–	0	–	–	1	2	2	–	1	–	1	2	1	3	–	2
	Derbestia spp.	–	–	–	–	–	–	X	X	–	–	–	–	2	–	–	–	2
	Enteromorpha spp.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Ulva spp.	1	–	1	X	–	0	–	1	–	0	–	–	–	1	–	–	–
	Other green algae	–	–	–	–	–	–	X	1	–	1	–	1	2	1	3	–	–
PHAEO-PHYTA	*Agarum fimbriatum*	0	–	–	–	0	0	0	0	0	0	–	0	0	–	0	0	0
	Colpomenia spp.	–	–	–	–	–	–	2	X	X	2	–	2	2	2	–	–	–
	Cystoseira spp.	2	–	0	2	3	0	0	1	0	0	0	0	1	1	0	1	2
	Desmarestia spp.	2	1	2	0	–	0	2	1	1	1	1	2	1	1	2	3	1
	Dictyoneuropsis	0	1	–	–	1	0	0	0	–	0	0	0	0	0	0	0	0
	Dictyota/Pachydictyon	2	–	3	–	–	–	2	2	X	2	2	?	2	1	–	2	2
	Eisenia arborea	3/j1	2/j2	2/j2	0	–	1/j1	2/j2	3/j3	0/j1	1/j2	0/j2	1/j2	0/j1	1/j1	1/j1	0/j1	2/j2
	Laminaria farlowii	–	1/j1	0	2	2/j2	0/j0	0	1	0	0	1/j0	0	1/j1	1	0	0	2/j?
	Macrocystis pyrifera	4/j2	3/j1	2/j2	3/j3	2/j1	0/j0	2/j1	4/j3	0/j1	1/j1	0/j2	1/j2	2/j1	1/j1	1/j1	2/j3	3/j2
	Pterygophora californica	2/j2	2/j1	2/j2	3/j3	2/j2	0/j0	0	0	0	0	0	0	0	0	0	0	1/j0
	Sargassum muticum	0	0	–	0	0	0	1	1	0	0	0	0	1	0	0	3	0
	Sargassum horneri	0	0	0	0	0	0	2	1/j3	0	0	0	1	2/j3	0	0	0	0
	Other brown algae	2	–	–	–	–	1	2	2	–	2	–	1	–	1	1	2	2

Table C-2 (continued). Sites #21–37.

Taxon	Species	SMMM 21	SRCP 22	SRTC 23	SRCSAW 24	SRSP 25	SCDPM 26	SCPP 27	SCCVP 28	SCLS 29	SCPRF 30	ANKH 31	ANEFC 32	ANBSBR 33	ANLH 34	SBWA 35	SBGC 36	SBSER 37
RHODO-PHYTA	*Callophyllis* spp.	X	–	–	3	–	–	–	–	–	–	–	–	–	–	–	–	–
	Cryptopleura spp.	3	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–
	Fauchea spp.	1	–	X	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Gelidium spp.	0	–	1	–	–	0	0	2	–	–	1	0	0	1	?	0	2
	Gigartina spp.	2	2	2	2	X	0	1	1	0	–	0	0	1	1	0	0	1
	Laurencia spp.	–	–	–	–	–	3	2	1	3	3	3	3	1	2	X	2	X
	Mazzaella spp.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Membranoptera spp.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Microcladia spp.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	3
	Plocamium spp.	0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	–
	Polyneura spp.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	–
	Rhodymenia spp.	2	–	–	–	–	1	X	X	–	–	–	–	X	–	–	0	–
	Articulated coralline	2	2	2	2	3	1	1	1	1	2	1	1	1	1	1	1	3
	Encrusting Coralline	2	2	2	3	2	3	3	2	3	3	3	3	4	2	4	3	3
	Other red algae	3	4	–	3	2	–	2	3	2	2	X	3	1	–	2	2	–
	Misc. plant (diatom film or Phyllospadix spp.)	1	–	4	–	2	2	2	2	2	2	2	3	2	1	X	2	2

Table C-2 (continued). Sites #21–37.

Taxon	Species	SMMM 21	SRCP 22	SRTC 23	SRCSAW 24	SRSP 25	SCDPM 26	SCPP 27	SCCVP 28	SCLS 29	SCPRF 30	ANKH 31	ANEFC 32	ANBSBR 33	ANLH 34	SBWA 35	SBGC 36	SBSER 37
PORI-PHERA	*Haliclona* sp.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Hymenamphiastra (Acanthancora) cyanocrypta	X	–	–	2	–	–	–	–	–	–	–	–	–	0	X	–	–
	Leucetta losangelensis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Polymastia pacifica	–	2	–	–	3	–	–	–	–	–	–	–	–	–	–	–	–
	Tethya aurantia	3	3	3	2	2	3	2	2	2	2	1	2	2	3	1	2	2
	Other sponges	4	2	2	2	x	2	2	2	1	1	2	2	2	2	2	2	3
ANTHO-ZOA	*Anthopleura* spp.	2	2	2	2	3	2	2	1	X	2	1	–	1	2	–	?	2
	Astrangia lajollaensis	1	2	0	1	–	2	3	1	3	2	3	1	1	2	1	0	2
	Balanophyllia elegans	2	3	3	2	2	2	2	2	1	2	2	1	1	1	2	1	2
	Clavularia spp.	–	0	–	–	–	–	–	–	–	2	2	–	–	2	–	0	–
	Corynactis californica	2	2	3	2	2	2	2	1	3	4	2	3	2	3	3	2	2
	Lophogorgia chilensis	0	0	1	0	0	4	2	3	2	3	3	1	2	2	1	2	1
	Metridium spp.	0	0	0	0	0	0	0	0	0	0	0	–	0	0	0	0	0
	Muricea californica	0	0	0	0	0	2	1	1	1	2	2	1	1	4	1	2	1
	Muricea fruticosa	0	0	0	0	0	1	0	1	0	0	1	1	1	1	1	1	0
	Parazoanthus lucificum	0	0	0	0	0	0	0	X	0	0	1	–	1	1	0	0	0
	Urticina lofotensis	3	–	2	2	2	0	1	0	0	0	0	0	–	0	0	0	0

Table C-2 (continued). Sites #21–37.

Taxon	Species	SMMM 21	SRCP 22	SRTC 23	SRCSAW 24	SRSP 25	SCDPM 26	SCPP 27	SCCVP 28	SCLS 29	SCPRF 30	ANKH 31	ANEFC 32	ANBSBR 33	ANLH 34	SBWA 35	SBGC 36	SBSER 37
HYDRO-ZOA	*Hydroids*	–	–	2	2	–	3	–	–	2	–	–	–	2	–	–	–	3
	Aglaophenia struthionides	X	2	–	2	3	–	2	–	–	–	–	–	–	0	–	0	–
	Hydractinia milleri	0	0	–	–	–	–	–	–	–	3	X	–	–	0	X	0	–
	Plumularia spp.	–	1	–	2	2	–	–	–	–	X	–	–	X	2	–	0	–
	Stylaster californicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
ANNELIDS	*Diopatra ornata*	1	2	1	2	3	2	1	2	2	2	2	1	1	1	1	–	3
	Dodecaceria fewkesi	2	1	X	–	1	2	1	–	1	2	2	–	–	2	X	–	–
	Phragmatopoma californica	1	2	2	2	1	1	0	0	1	1	1	0	0	1	1	0	2
	Salmacina tribranchiata	0	0	0	1	1	–	1	2	1	2	1	X	–	0	X	–	2
	Spirobranchus spinosus	0	0	2	2	1	2	2	1	3	2	2	2	2	2	2	–	2
ARTHRO-PODA/ Crustacea	*Balanus* spp.	X	1	1	1	1	–	2	3	–	3	1	1	X	2	2	1	1
	Cancer spp.	2	2	2	2	1	1	1	–	1	2	1	1	–	1	1	1	2
	Panulirus interruptus	0	0	0	0	0	1	2	2	1	0	0	0	3	1	1	1	2
BRYOZOA	*Bugula californica*	1	2	2	2	2	2	2	X	X	2	1	–	2	2	X	2	4
	Costazia costazi	2	X	–	–	1	–	X	–	X	–	–	0	X	0	–	0	–
	Diaperoecia (Diaperoforma) californica	1	2	2	2	–	2	2	3	2	1	2	2	1	1	2	1	3
	Other bryozoans	3	2	2	2	3	2	2	2	1	2	1	2	1	2	X	2	3

Table C-2 (continued). Sites #21–37.

Taxon	Species	SMMM 21	SRCP 22	SRTC 23	SRCSAW 24	SRSP 25	SCDPM 26	SCPP 27	SCCVP 28	SCLS 29	SCPRF 30	ANKH 31	ANEFC 32	ANBSBR 33	ANLH 34	SBWA 35	SBGC 36	SBSER 37
TUNICATES	Tunicate	4	3	3	2	3	2	2	2	1	2	2	1	1	1	2	–	3
	Styela montereyensis	2	3	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0
	Misc. Invertebrate	**3**	**3**	–	–	–	–	3	2	2	2	2	–	1	2	2	–	–
MOLLUSCA	*Aplysia californica*	0	0	1	0	0	2	2	1	2	2	2	2	0	2	2	1	1
	Crassedoma gigantea	2	2	1	2	1	2	2	4/j3	1	2	2	2	1	2	2	1	2/j3
	Cryptochiton stelleri	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cypraea spadicea	2	1	2	2	2	2	2	2	2	2	2	3	1	1	2	2	2
	Haliotis assimilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Haliotis corrugata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	S	0	0
	Haliotis fulgens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Haliotis rufescens	4/j1	1	1	2	2	0/j1	0	0	0	0	0	0	0	0	S	0	0
	Haliotis sorenseni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Kelletia kelletii	2	4	0	0	1	1	1	1/j	1	1	1	1	0	1	1	0	0
	Lithopoma gibberosa	3	2	1	0	–	1	2	1	1	1	0	1	0	1	2/j4	0	1
	Megastraea undosa	0	1	0	0	1	2	2	1	1	2	1	1/j2	1	2	2/j4	1/j0	2
	Megathura crenulata	2	2	2	2	1	4	2	2	2	2	1	2	1	2	3	0	1
	Octopus spp.	0	0	0	X	1	–	X	1	X	–	1	–	1	1	X	0	2
	Serpulorbis squamigerus	2	2	1	2	–	1	2	3	2	2	2	X	1	1	2	1	2
	Tegula regina	0	0	0	0	0	2	2	2	2	1	2	2	1	1	3/j0	–	3

Table C-2 (continued). Sites #21–37.

Taxon	Species	SMMM 21	SRCP 22	SRTC 23	SRCSAW 24	SRSP 25	SCDPM 26	SCPP 27	SCCVP 28	SCLS 29	SCPRF 30	ANKH 31	ANEFC 32	ANBSBR 33	ANLH 34	SBWA 35	SBGC 36	SBSER 37
ECHINO-DERMATA	*Centrostephanus coronatus*	0	0	0	0	0	1	2	1/j1	2	2	2/j2	2	2	2/j1	1/j1	1	2
	Cucumaria spp.	1	3	2	X	4	2	3	3	2	3	2	2	2	2	X	–	2
	Dermasterias imbricata	2	2	3	2	2	0	0	0	0	0	0	0	0	0	0	–	0
	Henricia spp.	2	3	X	3	–	–	X	X	1	–	–	–	1	0	X	–	2
	Lytechinus anamesus	0	0	0	0	0	1	1	0	2	2	2/j2	2/j1	1	1	1	0	0
	Ophiothrix spiculata	0	1	X	1	1	0	1	1	1	3	2	4	4	3	3	3	2
	Pachythyone rubra	0	0	2	0	2	1	3	1	0	1	0	0	0	1	0	0	1
	Parastichopus californicus	1	0	0	1	–	1	1	0	0	0	0	1	0	0	0	0	0
	Parastichopus parvimensis	2	2	2	2	1	2	2	2	2	2	3	1	3	2	1	2	1
	Patiria miniata	3	4	4	3	3	2	2	1	2	2	2	2	1	3	2	2	1
	Pisaster giganteus	3	3	4	3	2	2	2	2	2	2	1	2	2	2	1	1	2
	Pisaster ochraceus	1	0	0	0	0	2	1	2	3	2	1	1	0	2	0	1	0
	Pycnopodia helianthoides	2	2	2	2	3	2	0	0	0	–	0	1	0	1	1	1	0
	S. purpuratus	1/j1	2/j1	2/j	2/j2	3	3/j1	3	3/j1	4/j1	3/j1	3/j1	3/j1	1/j1	3/j1	4/j1	2/j2	2/j1
	S. francsicanus	2/j1	2/j1	2/j	3/j1	3	3/j1	2	2/j1	3/j1	2/j1	2/j1	3/j0	1/j1	2/j1	2/j0	2/j1	3/j1

Table C-2 (continued). Sites #21–37.

Taxon	Species	SMMM 21	SRCP 22	SRTC 23	SRCSAW 24	SRSP 25	SCDPM 26	SCPP 27	SCCVP 28	SCLS 29	SCPRF 30	ANKH 31	ANEFC 32	ANBSBR 33	ANLH 34	SBWA 35	SBGC 36	SBSER 37
FISH	*Lythrypnus dalli*	0	0	–	–	0	1	1	1	1	1	0	0	1/j1	0	0	0	0
	Coryphopterus (Rhinogobiops) nicholsii	1	1	–	–	2	2	2	2	3	4	4	4	4	4	2	2	2
	Alloclinus holderi	0	0	–	–	0	1	1	1	0	1	2	1	2	1	1	–	1

Appendix D. Site Field Notes

Site summaries are listed in order of site number. Refer to Figure 1 (page 9) for list of sites and their locations. Refer to Table 4 (page 7) for site information.

These site summaries are site notes we wrote in the field, which were edited for some grammatical errors. In previous years (1990–2012), we edited these notes, added data and that was the main body of the annual report. Now with the 33 long term monitoring sites instead of the original 16, we streamlined the reporting process by publishing the field notes and emphasizing the information and species summaries that are not the body of this report.

Site #1, Wyckoff Ledge, San Miguel Island

2013 status: Mature kelp forest

Sampling Dates
10/19/13: 5m^2 quadrats, random point contacts and size frequencies for *Strongylocentrotus franciscanus*, *S. purpuratus* and *Macrocystis pyrifera.*

10/20/13: Fish transects, video transects, roving diver fish counts, fish size frequencies, 1m^2 quadrats, band transects and size frequencies for *S. purpuratus, S. franciscanus, Patiria miniata, Pisaster giganteus, Pycnopodia helianthoides, Astraea gibberosa, Crassedoma giganteus, Megathura crenulata, Kelletia kelletii, Tethya aurantia,* and *Haliotis rufescens* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes
This site continued to be a mature kelp forest with large, widely-spaced *Macrocystis pyrifera* plants and a thick canopy. Canopy cover was estimated at 70%. There were some dense patches of *Pterygophora californica*. There were not as much red algae as in recent years, but that could be a result of the later than usual sampling dates this year. The bottom low lying sand stone was often bare and scoured. High relief areas were covered with tiny *Balanus* sp. which was notable at this site as with other sites this year. *Urticina lofotensis* was abundant on many of the rocks. *Cancer* sp. was very common. *Polyclinum* sp. was mostly small but several large individuals were observed. One *Cryptochiton stelleri* was found at the site. *Melibe leonina* was common and most were large. *Haliotis rufescens* were measured during band transects on all of the offshore side, including between the bands. This was also done on the onshore side for bands 11 and 12, including between those bands. However, the observer conducting band transect surveys on the onshore side only measured abalone on the actual band transects for 1 thru 10, so no *H. rufescens* were measured in between those bands. It was estimated that there were 20–30 individuals not measured as a result. Overall David Kushner thinks *H. rufescens* were as abundant as or more abundant than last year. No *Kelletia kelletii* eggs were observed this year. *Megathura crenulata* were mostly very large. *Bursa californica* was moderately abundant for this site. At least three *Parastichopus californicus* were observed. *Parastichopus parvimensis* were notably large. Fourteen *Pycnopodia helianthoides* under 10 mm were counted on band transects on the offshore bands. However, they were later removed from the datasheet and not entered into the database. This is because no *P. helianthoides* this small have ever

been recorded in the database or observed at any KFM sites before (see also Yellowbanks, Santa Cruz Island). Also, they have an ecologically insignificant impact at that small size. One *Galeorhinus galeus*, soupfin shark, approximately 6 feet was observed on 10/19/13 and one was observed on 10/20/13. Several *Cephaloscyllium ventriosum*, swell shark, were seen at the site. The most common miscellaneous invertebrate recorded on RPCs was barnacles.

Site #2, Hare Rock, San Miguel Island

2013 status: Dominated by Strongylocentrotus franciscanus

Sampling Dates

10/19/13: Fish transects, video transects, fish size frequencies, roving diver fish counts, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Patiria miniata, Pisaster giganteus, Pycnopodia helianthoides, Lithopoma gibberosa, Crassedoma giganteus, Megathura crenulata, Kelletia kelletii, Tethya aurantia* and *Macrocystis pyrifera* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

Overall the site was similar to last year and is dominated by small and large *S. franciscanus*. Canopy cover was estimated at 5%. There were three patches of *Macrocystis pyrifera* on the transect. A total of about 60 plants were present at the site. All had masses of urchins, mostly *S. franciscanus,* feeding on the holdfasts. These had to be removed in order to measure the holdfasts. David Kushner found it amazing the plants were still attached to the substrate. In the low-lying cobble areas there were several dense patches of *Ulva* sp. and on the tops of rocks there were several old (mostly eaten) *Desmarestia* sp. plants. The*y* were being eaten by *S. franciscanus*. Only one *Eisenia arborea* plant was observed and it was being eaten by *S. franciscanus.* There was also a bit of red algae on the bottom. Other than that, it was mostly encrusting coralline algae. On the tops of the higher relief parts of the site *Corynactis californica* and other encrusting invertebrates were covering the substrate. *Phragmatopoma californica* was mostly small and in shallow areas. Barnacles were abundant in the low-lying cobble areas. *Pisaster giganteus* was observed feeding on them. *Styela montereyensis* were small and only three were observed. *Aplysia californica* juveniles were mostly small. *Haliotis rufescens* small fresh shells were common. No *Lithopoma gibberosa* juveniles observed this year, but last year recruits seemed to show up in the size cohorts. Only three *Megathura crenulata* were observed. One large *Melibe leonina* was observed. No *Dermasterias imbricate* were observed at the site though they were common last year. *Parastichopus parvimensis* were notably very large. Ten very small *Chromis punctipinnis* YOY were observed. They were still partially translucent. After RDFCs were conducted, two *Neoclinus* sp. and one large *Rhacochilus vacca* were observed. The most common miscellaneous invertebrates recorded on RPCs were *Dodecaceria fewkesi* and barnacles. Over eight harbor seals were observed at the site.

Site #3, Johnson's Lee North, Santa Rosa Island

2013 status: Mature kelp forest

Sampling Dates

07/17/13: Fish transects, video transects, roving diver fish counts, fish size frequencies, and size frequencies for *S. purpuratus* and *S. franciscanus,* were completed.

08/13/13: 1m^2 quadrats, 5m^2 quadrats, band transects, random point contacts and size frequencies for *Patiria miniata, Pisaster giganteus, Pycnopodia helianthoides, Megastraea undosa, Crassedoma giganteus, Megathura crenulata, Tethya aurantia, Haliotis rufescens* and *Macrocystis pyrifera* were completed. All nine ARMs were sampled for all indicator species. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

The site was similar to past years and continues to be a mature kelp forest with mostly large widely spaced kelp plants and a moderate understory of *Pterygophora californica*, *Laminaria farlowii* and a lesser amount of *Eisenia arborea* and *Cystoseira* spp. Kelp canopy cover on 7/17/13 and 8/13/13 was estimated at 30% and 80%, respectively. Red algae were common as was *Gigartina corymbifera*. *Macrocystis pyrifera* holdfasts were notably large. Overall, there was nothing unusual or notable this year, other than most of the kelp plants were notably large and it appears there are more *Haliotis rufescens*. The garibaldi that has been at meter 72 seemed to have moved its nest a few meters. If it is the same fish it was looking its age and a bit old and unkempt. During our first visit we observed an unusually high number of garibaldi (5) for this site. During our second visit only two were observed, which is closer to a normal count for this species. Tunicates were abundant and included *Didemnum* sp., *Pycnoclavella* sp., *Clavelina* sp. and other encrusting tunicates. *Styela montereyensis* were common with all sizes present. *Crassedoma gigantea* were common and mostly small. Forty-four *Haliotis rufescens* were found for size frequency measurements while conducting band transect surveys. *Megastraea undosa* were rare and all were notably large, similar to past years. The most common miscellaneous invertebrates observed during RPCs were hydroids. *Parastichopus parvimensis* were rare and mostly large. *Pycnopodia helianthoides* were abundant with all sizes present. *Strongylocentrotus franciscanus* adults were moderately abundant and notably large while juveniles were rare. During the 8/13 visit, at least 12 small swell sharks were observed. Three juvenile *Sebastes serriceps* were observed, all in three ARMs. The ARMs were encrusted with a lot of sponges and tunicates on the bricks. Some bricks had to be replaced at the north end ARMs group, about 4 or 5 total.

Site #4, Johnson's Lee South, Santa Rosa Island

2013 status: Mature Kelp Forest

Sampling Dates

06/26/13: Fish transects, video transects, roving diver fish counts, fish size frequencies, and size frequencies for *S. purpuratus* and *S. franciscanus* were completed. Sampling of all seven ARMs were conducted.

07/18/13: 1m^2 quadrats, 5m^2 quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Patiria miniata, Pisaster giganteus, Pycnopodia helianthoides, Crassedoma giganteus, Tegula regina, Megathura crenulata, Kelletia kelletii, Tethya aurantia, Haliotis rufescens* and *Macrocystis pyrifera* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

Overall this site was similar to recent years. It continued to be a mature kelp forest with mostly large, widely spaced *Macrocystis pyrifera* plants and a relatively thick canopy. Understory algae appeared less abundant than what we commonly see here, presumably from the low light conditions on the bottom. There were few subadult *M. pyrifera* plants. Canopy cover of *M. pyrifera* was estimated at 100% during both visits. No sea urchin wasting disease was observed. *Boltenia villosa* were notably common. *Aplysia californica* were rare with only one or two large individuals observed. One *Cryptochiton stelleri* was observed. The most common miscellaneous invertebrates observed during RPCs were hydroids. The ARMs were in good condition and did not move during the winter season. One *Brosmophycis marginata*, red brotula, and one *Nautichthys oculofasciatus*, sailfin sculpin, were observed in the ARMs. No abalone were observed in the ARMs.

Site #5, Rodes Reef, Santa Rosa Island

2013 status: Open area with moderately high density of Strongylocentrotus franciscanus

Sampling Dates and Work Completed

09/19/13: Fish transects, video transects, roving diver fish counts, fish size frequencies, 1m^2 quadrats, 5m^2 quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Patiria miniata, Pisaster giganteus, Pycnopodia helianthoides, Lithopoma gibberosa, Crassedoma giganteus, Megathura crenulata, Kelletia kelletii, Tethya aurantia* and *Macrocystis pyrifera* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

Overall this site was similar to past year and was mostly covered with encrusting coralline algae. There was zero canopy cover. There were patches of *Desmarestia* spp. and one small patch of approximately 30 subadult *Macrocystis pyrifera* plants about seven meters north of the transect. Only one juvenile *Laminaria farlowii* was observed. There was a small amount of red algae present. Other green algae were not observed at the site but was not looked for. The eastern end of the transect had few *Diopatra ornata*. They were common and scattered around the site in the low-lying areas, but not in dense patches that were common in the 1990s and 2000s. There was a notably large number of *Lithopoma gibberosa.* Many were from the two-year size class from the recruits that were abundant at this site last year. There were also many that were too large to be from that cohort. Barnacles were abundant. There were unusually high-density patches of recruitment where small barnacles covered the bottom. Several *Pugettia producta* and *Cancer antennarius* were observed. One *Loxorhynchus grandis* was observed. One *Panulirus interruptus* was observed during band transects. *Aplysia californica* were rare with only one small individual observed. Only several small (<10cm) *Crassedoma gigantea* were observed. *Cypraea spadicea* were common in the rocky relief areas and

were notably large. Two small, fresh *Haliotis rufescens* shells were observed. *Kelletia kelletii* adults were common and juveniles were rare with several very small individuals observed. *Megathura crenulata* were rare at the site and all were notably large. *Melibe leonina* were abundant. Inshore of Rodes Reed, Santa Rosa Island, hundreds of aggregating *M. leonina* were observed. The most common miscellaneous invertebrates observed during RPCs were almost entirely barnacles. *Parastichopus parvimensis* were rare and notably large. *Patiria miniata* were abundant with all sizes present and lots of small ones observed. *Pycnopodia helianthoides* were moderately abundant and both adults and juveniles were notably small. *Strongylocentrotus purpuratus* were very rare with only five found for size frequency measurements. *Strongylocentrotus franciscanus* were scattered around the west end of the transect but were also in small patches and fronts all around the transect. Small and large individuals were found together throughout the site. Only ten *Coryphopterus nicholsii* were observed. At least one ronquil was observed. The most common miscellaneous invertebrate recorded on RPCs were barnacles. This category consisted almost entirely of barnacles.

Site #6, Gull Island, Santa Cruz Island

2013 status: State of transition

Sampling Dates and Work Completed

06/24/13: Fish transects, fish size frequencies, video transects, roving diver fish counts, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *Lytechinus anamesus, Patiria miniata, Pisaster giganteus, Pycnopodia helianthoides, Megastraea undosa, Lithopoma gibberosa, Crassedoma giganteus, Megathura crenulata, Kelletia kelletii,* and *Macrocystis pyrifera* were completed. Size frequencies for *S. purpuratus, S. franciscanus* and *Tethya aurantia* were not completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

10/18/13: Ten of the 14 ARMs were sampled for all indicator species. The remaining fifty size frequencies for *S. purpuratus,* 150 for *S. franciscanus* and size frequencies for *Stylaster californica* were completed.

10/21/13: The remaining four ARMs were sampled for all indicator species. Size frequencies for *Patiria miniata, Pisaster giganteus,* and *Lophogorgia chilensis,* were completed.

Site Notes

This site was similar to last year, but with notably less *Macrocystis pyrifera* on the onshore side of the transect. Kelp canopy cover on 6/24/13 and 10/18/13 was estimated at 20% and 25%, respectively. There were also notably less understory algae of all species. The transect from 0 to 45 meters remained dominated by *Strongylocentrotus purpuratus* and they seem to have notably increased in size over the past several years. From 0 to 45, nearly all the *M. pyrifera* are large adults and on the offshore side of the transect. In the high relief areas, the bottom was completely covered with encrusting invertebrates (bryozoans, etc.). *Agarum fimbriatum* adults and juveniles were common, but less abundant than last year. *Eisenia arborea* adults and juveniles appeared less abundant than last year. *Tethya aurantia* were notably abundant with all sizes present, mostly meters zero and 40. *Garveia* spp. was notably abundant approximately 5 to 10 meters offshore of the

transect at around the 55-meter mark. This hydroid was common at the 100-meter end of the transect for many years and has notably declined to being rare since. There was notably more and in different areas than in earlier years. During the 6/24 visit, one *Panulirus interruptus* was observed near the transect and was about legal size. During the 10/18 visit, at least six large lobster were on the transect from 50–100 meters. There were also several large molts found during that visit. One very fresh *Haliotis rufescens* shell measuring 81mm was found. The shell still had some flesh in it. This was a very flattened shell, an indication of rapid growth. One juvenile *H. corrugata* was found in the ARMs. Two juvenile *Kelletia kelletii* were found in the ARMs. The most common miscellaneous invertebrate sampled during RPCs was hydroids. *Ophiothrix spiculata* were moderately abundant and present mostly on the 0 to 40-meter end of the transect. *Parastichopus californicus* were common with at least eight observed at the site. *Pycnopodia helianthoides* were common and all notably large. *Alloclinus holderi* were rare with one small one observed after the fish count. All of the benthic fish, and even other fish were notably more abundant at 1800–2000 hours in our later dives. At least four *Ophiodon elongates* and five small adult *Scorpaenichthys marmoratus* were observed. David Kushner doesn't remember ever seeing so many at this site. Also, at least five juvenile *S. marmoratus* at about 7cm were observed, smaller than the ones observed at Santa Barbara Island. The coloration on these individuals was dull. *Sebastes atrovirens*, *S. chrysomelas*, S. carnatus and *S. serriceps* were all notably more active, visible and out of the crevices in the evening. In the ARMs several very small (~ 5–7cm long and very skinny) *Parastichopus parvimensis* were observed. There was a moderate number of juvenile *S. franciscanus* and *S. purpuratus* in the ARMs. Five juvenile *Centrostephanus coronatus* were observed in the ARMs. The most common miscellaneous invertebrate recorded on RPCs was hydroids.

Site #7, Fry's Harbor, Santa Cruz Island

2013 status: Mature Kelp Forest

Sampling Dates and Work Completed

06/27/13: Fish transects, video transects, roving diver fish counts, fish size frequencies, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Patiria miniata, Pisaster giganteus, Pycnopodia helianthoides, Crassedoma giganteus, Tegula regina, Megathura crenulata, Kelletia kelletii, Tethya aurantia* and *Macrocystis pyrifera* were completed. Sampling of all five ARMs were conducted. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

The site was a mature *Macrocystis pyrifera* forest with mostly large, widely spaced plants. There was a moderate understory of *Eisenia arborea* and a few *Laminaria farlowii* plants. Canopy cover was estimated at 80%. Red algae were moderately abundant in some areas, especially on the northern end of the transect. Bryozoans were notably abundant and diverse. Most notable is what seemed to be a large increase in *Hippodiplosia* sp., though David Kushner is not 100% sure about this ID. This bryozoan covered much of the area on the northern side of the transect and was growing epiphytically on algae. Other bryozoans were notably very abundant and consisted of *Hippodiplosia* sp., *Bugula* sp., *Thalamoporella* sp. and *Membranipora* sp. Much of the understory algae and rocks

were almost completely covered with these bryozoans. *Astrangia lajollaensis* were abundant as usual for this site. *Lophogorgia chilensis* were moderately abundant and more prevalent on the deeper, offshore side of the transect. *Diopatra ornata* were moderately abundant in the low-lying areas and were notably large. No *Panulirus interruptus* were observed, but two molts were present. There was a group of approximately seven large *Aplysia vaccaria* in a mating aggregation with eggs. *Kelletia kelletii* were common. There was a notably small size class at around 70 mm. No *Megastraea undosa* were observed. Four separate pairs of *Megathura crenulata* were observed on top of each other. Only one *Tegula regina* was observed. *Pachythyone rubra* were common and there was notable patch of them inshore at the zero end of the transect. A few others were scattered around the site. At least three *Parastichopus californicus* were observed. *Pisaster giganteus* were moderately abundant and mostly small. Juvenile *Strongylocentrotus franciscanus* and *S. purpuratus* were notably rare, even in the ARMs. Approximately 12 *Lythrypnus dalli* were observed. Only two *Alloclinus holderi* were observed. Overall there is an incredible number of fish at this site. In addition to that, the numerous cracks and crevices make it nearly impossible to assess the entire site in 30 minutes. Because of all the crevices, we likely underestimate *Sebastes atrovirens*, *S. chrysomelas*, and S. carnatus**.** One ronquil sp., several *Lythrypnus zebra* and one male *Halichoeres semicinctus* were observed after the fish count.

Site #8, Pelican Bay, Santa Cruz Island

2013 status: Dominated by Strongylocentrotus purpuratus

Sampling Dates and Work Completed

09/17/13: Fish transects, video transects, fish size frequencies, roving diver fish counts, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Lytechinus anamesus, Patiria miniata, Pisaster giganteus, Pycnopodia helianthoides, Megastraea undosa, Crassedoma giganteus, Tegula regina, Megathura crenulata, Kelletia kelletii, Lophogorgia chilensis* and *Tethya aurantia* were completed. All six ARMs were sampled for all indicator species. ARM cages 2312, 2317 and 2316 were replaced. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

Overall the site has changed little and appeared more barren than in recent years. There was more sand over the transects area and there was no kelp canopy cover present. The site was dominated by *Strongylocentrotus purpuratus*, but possibly fewer than last year. *Strongylocentrotus franciscanus* were common and scattered around the site. The site was nearly devoid of macro algae, even on the tops of the rocks. There was a small amount of *Laurencia* sp. and *Codium fragile*. *Desmarestia* sp. was present on the deep side of the transect. *Desmarestia* sp. was abundant just offshore of the band transects, outside of the site. *Lophogorgia chilensis* were common. Many lacked polyps and were covered by silt. Nearly all of the *L. chilensis* at the site were measured for size frequencies. The most common miscellaneous invertebrates recorded during RPCs were *Balanus* sp. and *Mesochaetopterus taylori*. *Balanus* sp. were abundant over much of the site and recruits were especially common. *Panulirus interruptus* were rare with two observed; one small and one of legal size. *Aplysia californica* were rare with five observed on the entire offshore side. Four of those were counted on

the band transects. Two juvenile *Haliotis rufescens* were found in the ARMs. *Kelletia kelletii* adults were common at the site and juveniles were moderately abundant inside of the ARMs. Only one small and one medium sized *Megastraea undosa* were observed. *Megathura crenulata* were rare and most were large. *Centrostephanus coronatus* were not observed and possibly absent from the site. Several small sand dollars were present at the site. There were also dense sand dollar beds near the site area as well. Signs of predation on the sand dollars were also noted. *Pachythyone rubra* were rare at the site, but notably common inshore of the transect in about 7–10ft of water. *Parastichopus parvimensis* were notably rare with at least three observed on the offshore side of the transect and two observed on the inshore side. Most of these individuals were large. The ones found in the ARMs were all notably small, even the ones greater than 10cm. *Pycnopodia helianthoides* were rare with at least one (150 cm) observed. *Lythrypnus dalli* were rare with one 10 mm recruit and one adult observed. No *Alloclinus holderi* were observed. A school of approximately 70 *Caulolatilus princeps* ranging from 20–24 cm in length was observed. One notably large male sheephead estimated at 115 cm was observed at the site. Several divers commented that this was the largest sheephead that they had ever seen. Barnacles covered the bricks of all the ARMs. There was an abundance of juvenile *Kelletia kelletii* (15–29 mm) in the ARMs with up to 26 observed in a single ARM. This is by far more juvenile *K. kelletii* than we have ever seen in the ARMs since we began monitoring them in 1991. We also observed a few juvenile *K. kelletii* at Yellowbanks this year. The most common miscellaneous invertebrate recorded on RPCs were barnacles and *Mesochaetopterus taylori.*

Site #9, Scorpion Anchorage, Santa Cruz Island

2013 status: Dominated by Strongylocentrotus spp.

Sampling Dates and Work Completed

08/27/13: Fish transects, video transects, fish size frequencies, roving diver fish counts, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Patiria miniata, Pisaster giganteus, Megastraea undosa, Crassedoma giganteus, Megathura crenulata, Kelletia kelletii, Tethya aurantia,* and *Macrocystis pyrifera* were completed. All six ARMs were sampled for all indicator species. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

This site remained dominated by *Strongylocentrotus* spp., though *S. franciscanus* was less abundant than the past two years. There was no kelp canopy cover present. The substrate was mostly covered by encrusting coralline algae, similar to past years. However, there were some notable differences. There seemed to be more lobster than in previous years and most were notably large. About half of the *S. franciscanus* were in crevice habitat. There was a notable amount of ephemeral algae present. One patch of mostly subadult *Macrocystis pyrifera* plants were present on the north side of the transect around meter 95. The large rock on the inshore/ south side of the line at meter 93 is typically covered invertebrates and algae was almost entirely covered with coralline algae and *S. purpuratus*. *Sargassum muticum* was common and there were some notable small patches at the site, mostly on the western half. Only one *Gigartina* sp. plant was observed at the site. A *Scytosiphon* sp. like intertidal algae was common in patches towards the 100 m end of the transect. David Kushner is not

sure of the species, but this looked like the intertidal variety. In addition, the lower intertidal species *Halydrys* sp. juveniles were also present in the same area. As you moved shallower these were more common with adults in the lower intertidal areas off the transect. The most common miscellaneous invertebrates recorded during RPCs were *Spirobranchus spinosus. Tethya aurantia* were common and mostly small. *Corynactis californica* were common and occurred mostly in small colonies and did not look particularly healthy. *Lophogorgia chilensis* were rare with only three observed at the site. *Aplysia californica* were common and mostly small to medium sized. *Crassedoma gigantea* were common with all sizes present. *Cypraea spadicea* were rare at the site, but abundant in the ARMs. We observed signs of recent predation of *C. spadicea* at the site presumably from lobster or other similar crushing predators. Two small, fresh *Haliotis corrugata* shells were found. At least three fresh, small *Haliotis rufescens* shells were found. *Megastraea undosa* were rare with only three found for size frequencies. *Megathura crenulata* were common and mostly small to medium in size. *Tegula regina* were rare and only several were observed. *Lytechinus anamesus* were rare with only three observed. *Parastichopus parvimensis* were moderately abundant and mostly large. *Patiria miniata* were common and mostly large. *Pisaster ochraceus* were notably present and almost as common as *P. giganteus*. No *Alloclinus holderi* were observed. At least one *Myliobatis californica* was observed.

Site #10, Yellowbanks, Santa Cruz Island

2013 status: Kelp Forest

Sampling Dates and Work Completed

08/29/13: Fish transects, video transects, roving diver fish counts, fish size frequencies, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, Lytechinus anamesus, Patiria miniata, Pisaster giganteus, Pycnopodia helianthoides, Megastraea undosa, Lithopoma gibberosa, Tegula regina, Megathura crenulata, Kelletia kelletii, Tethya aurantia, Haliotis rufescens, Haliotis corrugata* and *Macrocystis pyrifera* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

09/16/13: Size frequencies for *S. franciscanus* were completed. Ten ARMs were sampled for all indicator species. Five ARMs were sampled for all indicator species except for *S. franciscanus* and *S. purpuratus.*

Site Notes

Overall this site was similar to recent years, but there were a few notable differences. Subadult *Macrocystis pyrifera* were dense over the first 50 meters of the transect, while larger adults were scattered around the transect. The other most notable difference was the continued increase (from the past few years) in *Strongylocentrotus franciscanus* and *S. purpuratus*. The *S. franciscanus* were also notably larger. Some patches of *S. franciscanus* nearly covered small rocks entirely on the western end of the transect. A moderate number of these urchins were at or near legal size, something not seen at this site in many years. *Macrocystis pyrifera* subadults were moderately abundant, while juvenile and adult plants were common. Canopy cover of *M. pyrifera* was estimated at 20%. *Tethya aurantia* were moderately abundant overall and very abundant in patches. *Corynactis californica* occurred in small colonies and were not very abundant. *Muricea californica* were rare and all were

large. *Panulirus interruptus* were rare with at least four observed. All were less than legal size. *Styela montereyensis* were rare with only several very small individuals observed. One *Haliotis corrugata,* measured at 122 mm, was observed. Two *H. rufescens* were observed and were measured at 78 mm and 160 mm. Both *Megastraea undosa* and *Lithopoma gibberosa* were moderately abundant, but few were directly along the transect. Therefore, $1m^2$ quadrat density estimates did not represent well what was present at the site. *Megathura crenulata* were common and at least three individuals were observed spawning. Pholads were observed spawning. The most common miscellaneous invertebrates recorded during RPCs were gorgonians and barnacles. Twenty-two small (<28 mm) *Centrostephanus coronatus* were observed in the ARMs. *Lytechinus anamesus* were moderately abundant, but most were very small. Sea urchin wasting disease was observed in approximately 3% of *Lytechinus anamesus.* No wasting disease was observed in *S. franciscanus* or *S. purpuratus*. No *Pycnopodia helianthoides* greater than 10 mm were observed. All of the individuals counted on band transects were tiny recent recruits. These were not entered into the database. This is because no *P. helianthoides* this small have ever been recorded in the database or observed at any KFM sites before (see also Wyckoff Ledge, San Miguel Island). A total of 68 were counted for a density of $0.094/m^2$. It is likely that many were missed and not counted due to their small size. An unusual number of *H. rufescens* and a few *H. corrugata* were present in the ARMs. No *Parastichopus parvimensis* were observed in any of the ARMs. Juvenile *S. purpuratus* were abundant in the ARMs and *S. franciscanus* were common. At least seven small *Orthasterias* sp. were observed in the ARMs. Similar to past years, abundance and diversity of fish at this site was low. Several coralline sculpins were observed.

Site #11, Admiral's Reef, Anacapa Island

2013 status: Dominated by Ophiothrix spiculata

Sampling Dates and Work Completed

07/19/13: Fish transects, video transects, fish size frequencies and roving diver fish counts were completed. Sampling of all 6 ARMs were conducted.

8/21/13: $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Patiria miniata, Pisaster giganteus, Megastraea undosa, Crassedoma giganteus, Tegula regina, Megathura crenulata, Kelletia kelletii, Lophogorgia chilensis, Muricea californica, Muricea fruticosa, Tethya aurantia* and *Macrocystis pyrifera* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

Overall the site is similar to recent years and nearly covered with *Ophiothrix spiculata*, except on the tops of the highest reef areas, mostly near the 100 m end of the transect. Except for a few subadult *Macrocystis pyrifera* plants on top of the reef and scattered juvenile *Eisenia arborea,* the site was devoid of macro algae. There was no kelp canopy cover present. Several *Codium fragile* were observed. One 5 cm juvenile *Cystoseira* sp. was observed at the site. *Desmarestia* sp. was rare with only small (< 10 cm) plants observed. Eight juvenile (< 5 cm) *Sargassum horneri* were observed on top of the reef on the inshore side at the 100 m end of the transect. The most common miscellaneous invertebrates recorded during RPCs were *Spirobranchus spinosus* and *Eugorgia rubens*.

Lophogorgia chilensis were common and most did not appear healthy. *Murcia californica* were common and most were large and healthy, with few unhealthy individuals. Six *Murcia fruticosa* were observed. Pyrosomes and *Beroe* sp. were notably abundant. Several anemones were observed feeding on pyrosomes. At least 6 crabs of the genus *Cancer* were observed at the site. Three *Panulirus interruptus* were observed at the site and one was large. *Aplysia californica* were rare with all sizes observed, one being very small. No live *Haliotis* spp. were observed, but one small (26 mm), fresh *Haliotis corrugata* shell was found. Only 16 *Megastraea undosa* were found for size frequencies and were all in a similar size class. *Megathura crenulata* were moderately abundant and mostly small. *Ophiothrix spiculata* were abundant and covered most of the site. *Parastichopus parvimensis* were notably small and notably more abundant than one would expect for an Anacapa Island site outside of the reserve. Adult *Strongylocentrotus purpuratus* were common, but patchy and in low densities. Juvenile *S. purpuratus* (3–6 mm) were notably common and more abundant than we have seen all year. One *Lythrypnus dalli* was observed on 8/21/13. Only three *Alloclinus holderi* were observed at the site. Three *Gymnothorax mordax* were observed. One small (~7 cm) medusa fish was observed on a pyrosome.

Site #12, Cathedral Cove, Anacapa Island

2013 status: Mature kelp forest

Sampling Dates and Work Completed

05/17/13: This dive was a proficiency dive for the identification of invertebrates and algae for the KFM staff new to the program. Size frequencies for *S. purpuratus, S. franciscanus, Patiria miniata, Pisaster giganteus, Megastraea undosa, Crassedoma giganteus, Megathura crenulata, Tethya aurantia, Haliotis corrugata,* and *H. rufescens* were completed.

05/31/13: Fish transects, video transects, roving diver fish counts, fish size frequencies, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *Macrocystis pyrifera* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

10/22/13: All seven ARMs were sampled for all indicator species.

Site Notes

Overall this site was similar to recent years and was a mature kelp forest with mostly large, widely spaced *Macrocystis* plants and a thick understory. Canopy cover on 5/31 and 10/22 were estimated at 75% and 80%, respectively. A large patch of adult and juvenile *Sargassum horneri* was observed on 5/17 and 5/31. Sponges were common and consisted mostly of encrusting red sponges. *Panulirus interruptus* were not as abundant as past years during the 5/31 visit. They were mostly large but several very small individuals were present. However, during the 10/22 visit, *P. interruptus* were more abundant, and at least five very large males were observed. Bryozoans were notably abundant and dense, with wide cover of *Bugula* sp. evident. Miscellaneous invertebrates on RPCs were mostly hydroids. At least four very large *Aplysia vaccaria* were observed. Several fresh, cracked *Cypraea spadicea* shells were observed, possibly from lobster predation. Two live *Haliotis corrugata* were observed on band transects, as well as one fresh shell (136 mm). One *H. rufescens* was observed.

One *Lytechinus anamesus* was observed. *Strongylocentrotus purpuratus* were present mostly on the onshore side of the transect. Some evidence of predation on *S. franciscanus* (sheephead or lobster) was present. Four juvenile (9–11 cm) *Halichoeres semicinctus* were observed on 5/17. At least six juvenile *Hypsypops rubicundus* were observed on 10/22. ARM #2346 was missing four bricks (one layer) and we considered not using the data from that ARM; however, we all agreed that it is no different than a layer of bricks covered by silt or sand, which occurs regularly. Also, the data was similar to the other ARMs sampled at the site. So, the data was kept.

Site #13, Landing Cove, Anacapa Island

2013 status: Kelp Forest

Sampling Dates and Work Completed
06/28/13: Sampling of all six ARMs were conducted.

08/12/13: Fish transects, fish size frequencies, video transects, roving diver fish counts, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Pisaster giganteus, Megastraea undosa, Crassedoma giganteus, Tegula regina, Megathura crenulata, Kelletia kelletii, Tethya aurantia, Haliotis corrugata,* and *Macrocystis pyrifera* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes
Overall this site was similar to past years and continues to be a kelp forest. There were few large kelp plants and many of the small ones were located on the smaller cobble areas and had moved around a bit. On top of the reef at the 0 m end of the transect, there was a dense understory of *Gelidium* spp. and *Eisenia arborea*, similar to past years. In the low-lying areas, there was an abundance of *Eisenia arborea, Pterygophora californica, Laminaria farlowii* and *Dictyota/Pachydictyon* that covered nearly all the bottom. This made band transects and other protocols difficult and time consuming. During our first trip on 6/28 canopy cover of *Macrocystis pyrifera* covered approximately 15% of the site and seemed to be cropped by boat traffic. During our visit on 8/12, canopy cover appeared to cover only 5% of the site. *Laminaria farlowii* adults and juveniles were abundant in the low-lying areas. We observed five juvenile (< 3 cm) *Sargassum horneri* plants at three different locations on the transect. They were difficult to see because of the understory algae and there were most likely more that we missed. The $5m^2$ quadrat observers missed these, but we added them later as they were found along the transect. I believe this is the first time we have observed this alga at Landing Cove. *Gelidium* spp. was moderately abundant and covered the top of the reef as usual. In the high relief areas there was high encrusting invertebrate cover. The yellow sulfur sponge was common, as usual for this site. Several *Tylodina fungina* were observed. *Panulirus interruptus* were moderately abundant, though not as many large individuals were observed as were in past years. Bryozoans were moderately abundant and mostly growing epiphytically on algae. The most common miscellaneous invertebrates observed during RPCs were hydroids. Five *Haliotis corrugata* were observed; two were observed during band transects. Kushner recognized three from last year; two were smaller and new animals. *Megathura crenulata* were rare and mostly small. *Tegula regina* were rare and mostly small. *Patiria miniata* were rare and none were observed outside of the ARMs (there were 27 in the

ARMs). *Lythrypnus dalli* were rare with only two observed. *Alloclinus holderi* were rare and only one was observed after the RDFC. There were at least 12 small *Paralabrax clathratus,* ranging from 8–12 cm in size. David Kushner decided to put these in the juvenile category since they were most likely last year's recruits. We typically miss *P. clathratus* recruitment due to the timing of our sampling season. If these were not counted as juveniles, we would be missing these recruitment events in the data. Four juvenile *Hypsypops rubicundus* were observed and were likely recruits from this year. Adult and juvenile *Brachyistius frenatus* were abundant on the tops of the reef and in the kelp canopy; more abundant than at any other site we have sampled this season. There was a notable amount of juvenile *Kelletia kelletii* observed in the ARMs.

Site #14, Southeast Sea Lion Rookery, Santa Barbara Island

2013 status: Dominated by Ophiothrix spiculata

Sampling Dates and Work Completed

05/14/13: Fish transects, video transects, fish size frequencies, roving diver fish counts, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Patiria miniata, Pisaster giganteus, Megastraea undosa, Crassedoma giganteus, Tegula regina, Megathura crenulata, Tethya aurantia,* and *Macrocystis pyrifera* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

The site continued to be dominated by *Ophiothrix spiculata*, but there were patches where *O. spiculata* were less abundant than in past years. Those lower abundance patches were often around areas with algae and appeared to be from physical disturbance of *O. spiculata* by the algae due to swell. Algae were diverse, with at least 20 different species observed. Five subadult *Macrocystis pyrifera* plants were observed. Juveniles were scattered around the transect. More *M. pyrifera* was present at the site than has been observed in the last decade, and all looked healthy. The kelp forest appears to continue to expand. There was no kelp canopy; however, there was some present 50 m south of the site. *Desmarestia* was common in small patches. Several juvenile *Eisenia arborea* plants were observed, but no adults. Two small, reproductive *Sargassum horneri* plants were observed at 5 m mark along the transect. Red algae were notably diverse. *Corynactis californica* did not appear particularly healthy. Many *Lophogorgia chilensis* appeared unhealthy and possibly dying. *Muricea fruticosa* and *M. californica* appeared healthy. Two small and one large *Panulirus interruptus* were observed. Only two *Megathura crenulata* were observed. One or two *Octopus rubescens* were observed. *Strongylocentrotus franciscanus* were notably rare and most were small. We found only 42 for size frequency measurements. Fish abundance and diversity were low, with the exception of juvenile rockfish. Juvenile rockfish were abundant, but no adults were observed. *Sebastes miniatus* juveniles were more abundant than have been observed at any KFM site. Many other juvenile rockfish were present. The majority could not be positively identified but were believed to be a combination of *S. mystinus*, *S. serranoides*, and *S. entomelas*. All of the unidentified fish had elongate bodies, and most had a black dorsal spot. All had mottling, but the mottling differed between two different forms. One form was similar to juvenile blue coloring but faded. The other form looked like it was filling in and forming larger blotches. KGB juveniles were also common at

the site. Only three *Hypsypops rubicundus* were recorded. One large *Paralichthys californicus* was observed, but not recorded during a fish count.

Site #15, Arch Point, Santa Barbara Island

2013 status: Dominated by Strongylocentrotus spp.

Sampling Dates and Work Completed

05/13/13: Fish transects, fish size frequencies, video transects, roving diver fish counts, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Lytechinus anamesus, Patiria miniata, Pisaster giganteus, Megastraea undosa, Lithopoma gibberosa, Crassedoma giganteus, Tegula regina, Megathura crenulata, Tethya aurantia,* and *Macrocystis pyrifera* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

Overall this site was similar to past years and continued to be dominated by small *Strongylocentrotus purpuratus,* and to a lesser extent *S. franciscanus*. Juvenile *S. purpuratus* were rare. Most of the *S. franciscanus* observed in quadrats were less than 25 mm. Though the site was mostly devoid of macro algae there were two subadult *Macrocystis pyrifera* plants that nearly reached the surface as well as several juvenile plants. No kelp canopy was present. One adult and several juvenile *Eisenia arborea* were present. *Desmarestia* spp. were present, but rare and mostly heavily grazed down to a small size. Most of the bottom was covered with encrusting coralline algae and there was very little *Laurencia* sp. *Sargassum muticum* was present near the 100 m end of the transect, similar to past years, and was reproductive. We neglected to measure the two *M. pyrifera* plants and we estimated them to have 20 cm holdfasts, and four stipes per plant. *Tethya aurantia* was rare with only one observed. *Anthopleura* spp. and *Cactosoma*/ *Sagartia* sp. were common. *Corynactis californica* were moderately abundant, mostly small and unhealthy-looking. *Phragmatopoma californica* was rare with a few colonies scattered around the site. *Spirobranchus spinosus* were common but notably less abundant than in past years. This species appears to have decreased gradually over the past 20 years. *Balanus* sp. were moderately abundant and most appeared to be from last year's recruitment rather than from this year's. *Panulirus interruptus* were rare with three to four lobsters observed. One large individual (~6 lbs.), one above legal size and one small individual were of those observed. On RPCs, the miscellaneous invertebrates category consisted of mostly barnacles, followed by hydroids. *Aplysia californica* were moderately abundant and mostly small. There were at least eight *A. vaccaria* along the lower part of the transect. Two small *Haliotis fulgens* shells were found and measured. One shell was fresh at 32 cm and one shell was older at 39 cm. *Lithopoma gibberosa* were rare with three small snails observed. However, they were larger than last year's recruits and possibly one or more years old. *Megastraea undosa* adults and juveniles were common with all sizes present and some notably small recruits observed. *Megathura crenulata* were rare and large with only two or three individuals observed. *Tegula regina* were moderately abundant with all sizes present and small individuals common. *Centrostephanus coronatus* were common with several small (< 15 mm) individuals observed. *Lytechinus anamesus* were common and most were small. *Parastichopus parvimensis* were common with many being notably large and fat. We counted *P. parvimensis* on

band transects with 14 observed. This is a much lower abundance estimate then observed on $1m^2$ quadrats. *Pisaster giganteus* were common in the shallower sections of the site, at approximately 20 ft. deep. These individuals were not recorded in the sampling protocol. Therefore, the $1m^2$ quadrat density estimate is lower than what is present over the entire site. Fish abundance and diversity was relatively low for this site. Only one *Paralabrax clathratus* was observed. *Alloclinus holderi* were notably rare with only two individuals observed. *Sebastes miniatus* juveniles were extremely abundant with more recruits observed then in any years prior. Juvenile rockfish were abundant in general at this site and we had difficulty identifying two or three species. We had similar problems with identifying neonate rockfish at the Southeast Sea Lion site as well and believe some of these unidentified miscellaneous rockfish are *S. mystinus* mixed in with *S. entomelas*. Many more *Citharichthys stigmaeus* were observed than in prior years. Many small *Oxylebius pictus* were observed, indicating a recent recruitment event.

Site #16, Cat Canyon, Santa Barbara Island

2013 status: Dominated by Strongylocentrotus purpuratus

Sampling Dates and Work Completed

06/12/13: Fish transects, video transects, roving diver fish counts, fish size frequencies, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Patiria miniata, Pisaster giganteus, Megastraea undosa, Lithopoma gibberosa, Crassedoma giganteus, Tegula regina, Tethya aurantia, Haliotis corrugata* and *Macrocystis pyrifera* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

This site, as well as the surrounding area, has notably changed. Canopy cover was estimated at 15%. The area directly east of the transect has a dense mature kelp forest with a thick canopy. Patchy *Macrocystis pyrifera* kelp is present all the way to the Southeast Reef site and is also patchy, though not as dense, to the west of the transect towards Sutil Island and Webster's Point. However, the bottom, even around most of the kelp, was still dominated by *Strongylocentrotus purpuratus*, though their densities have declined over 35% in the last two years. *Strongylocentrotus franciscanus* were common although notably less abundant than in past years. Only one *S. franciscanus* was observed with wasting disease. The bottom was mostly covered with coralline algae and *Phragmatopoma californica*, which had notably increased. *Desmarestia* spp. were common and consisted of mostly small plants. *Macrocystis pyrifera* were common with approximately 150 plants within the site. Two *Sargassum horneri* plants were observed at 20 cm and 70 cm in height and both were reproductive. Other brown algae were common and consisted of mostly *Dictyota/Pachydictyon* sp. for that category on the RPC protocol. *Phragmatopoma californica* were notably more abundant compared to last year and was one of the most notable changes at the site. *Spirobranchus spinosus* were common but continues to be notably less abundant than in the 1990s. *Balanus* sp. were common and were the most common miscellaneous invertebrates recorded on RPCs. *Sagartia/Cactosoma* sp. were also abundant miscellaneous invertebrates. At least three *Panulirus interruptus* were observed. Other bryozoans were common and *M. pyrifera* plants were covered with a moderate amount of

Membranipora sp., same as what was observed at the Southeast Reef site. Tunicates were moderately abundant with *Didemnum* sp. being particularly abundant. *Aplysia californica* were moderately abundant with all sizes present. *Crassedoma gigantea* were common and mostly small, similar to the Southeast Reef site. One live *Haliotis corrugata* was observed and measured 40 mm. *Pisaster ochraceus* were rare with eight observed during band transects. *Alloclinus holderi* were rare and most were small, but all sizes were present. Last year's recruits of *Oxyjulis californica* were observed in a school and were recorded on RDFC as juveniles. They were 9–11 cm in length. One *Squatina japonica* was observed near the 100 m end of the transect. Juvenile *Sebastes miniatus* were abundant with at least 16 observed during fish counts.

Site #21, Miracle Mile, San Miguel Island

2013 status: Mature kelp forest

Sampling Dates and Work Completed

08/15/13: Fish transects, video transects, roving diver fish counts, fish size frequencies, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Patiria miniata, Pisaster giganteus, Pycnopodia helianthoides, Lithopoma gibberosa, Crassedoma giganteus, Megathura crenulata, Kelletia kelletii, Tethya aurantia, Haliotis rufescens* and *Macrocystis pyrifera* were completed. All seven ARMs were sampled for all indicator species. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

Overall this site was similar to past years, though like everywhere this year the kelp plants were notably large and widely spaced with a high number of stipes. There was a thick canopy that covered approximately 95% of the site. This is more canopy cover than usual and may have contributed to less than normal understory algae on the bottom. On top of the reef there was notably less adult *Eisenia arborea*, though some were huge. Several *Laminaria setchellii* were observed. *Dictyota/ Pachydictyon* were more abundant than in recent years, possibly due to thick canopy. The sponge *Spheciospongia* sp. was common. The most common miscellaneous invertebrates recorded during RPCs were anemones and hydroids. *Stylantheca* sp. was present offshore of the main transect about 11 m. Tunicates were abundant; especially *Aplidium* sp. *Epiactis prolifera* anemones were everywhere. *Crassedoma gigantea* were common and mostly small. *Cryptochiton stelleri* were rare with one observed. *Haliotis rufescens* were abundant while juveniles were rare. Smaller individuals (< 100 mm) were common in crevices but overall were a low proportion of the total abalone counts. Few fresh shells were observed. Ten fresh *H. rufescens* shells were collected at the site ranging from 181 to 209 mm. One old *H. rufescens* shell was also collected. *Parastichopus parvimensis* were common and notably huge. *Parastichopus californicus* were rare with only one observed. *Pisaster ochraceus* were rare with only two observed. *Pisaster giganteus* were moderately abundant and mostly small. *Pycnopodia helianthoides* were common and mostly small. *Scorpaenichthys marmoratus* were notably abundant and most were very large, but at least one juvenile was observed. Juvenile *Embiotoca lateralis* were abundant with up to 18 observed during RDFC. Juvenile *Sebastes mystinus* were abundant, similar to most other KFM sites this year. ARM#2471 was on its side, but

was still able to be sampled. One ARM and three lids were replaced. ARM#2473 was changed to #2483.

Site #22, Cluster Point, Santa Rosa Island

2013 status: Mature kelp forest

Sampling Dates and Work Completed

08/14/13: Fish transects, video transects, roving diver fish counts, fish size frequencies, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Patiria miniata, Pisaster giganteus, Pycnopodia helianthoides, Megastraea undosa, Crassedoma giganteus, Megathura crenulata, Kelletia kelletii, Tethya aurantia, Haliotis rufescens* and *Macrocystis pyrifera* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

This site remains a mature kelp forest with notably large, widely spaced plants with high stipe counts. *Macrocystis pyrifera* appeared more abundant than in recent years. Canopy cover of *M. pyrifera* was approximately 80%. *Pterygophora californica* was moderately abundant though patchy in the low-lying areas of the transect. Understory red algae cover was minimal except for on the tops of reefs where it was moderately abundant. The site as well as the entire Cluster point area appeared to have more kelp canopy this year than since we began monitoring it. The site had almost entirely large kelp plants with high numbers of stipes. There was a dense canopy in some areas and in these areas the *P. californica* appeared to be senescing likely from low light conditions. *Laminaria setchellii* was common. *Tethya aurantia* were moderately abundant with all sizes present. The sponge *Spheciospongia* sp. was common. *Crassedoma gigantea* were common with all sizes present, but mostly small. *Cryptochiton stelleri* were rare with at least two observed at the site. *Megastraea undosa* were rare with one large individual observed. *Parastichopus parvimensis* were common and mostly large. *Pisaster giganteus* were moderately abundant and mostly small, though a few very large individuals were observed. *Pycnopodia helianthoides* were common with all sizes present. Near meter number 67 on the onshore side of the transect one *Anarrhichthys ocellatus* was observed. This is likely the same individual we have been observing at the same spot for the last several years. The most common miscellaneous invertebrates recorded during RPCs were *Cucumaria* sp. followed by hydroids.

Site #23, Trancion Canyon, Santa Rosa Island

2013 status: State of transition

Sampling Dates and Work Completed

06/25/13: Fish transects, video transects, fish size frequencies, roving diver fish counts, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Patiria miniata, Pisaster giganteus, Pycnopodia helianthoides, Lithopoma gibberosa, Crassedoma giganteus, Megathura crenulata, Tethya aurantia, Haliotis rufescens* and *Macrocystis pyrifera* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

Last year this site had the least number of algae observed since monitoring began. This year, macroalgae increased in abundance. *Macrocystis pyrifera* adults, subadults and juveniles were common, though present mostly on the tops of large rocks that are scattered throughout the site. Canopy cover of *M. pyrifera* was approximately 10%. *Desmarestia* spp. were also present on tops of large rocks and appeared less abundant then last year. *Eisenia arborea* appeared more abundant than in recent years and was observed mostly on the top of the reef and large rocks. The low-lying rocky sections of the site were mostly devoid of algae, though filamentous diatoms were abundant in these areas. *Tethya aurantia* were moderately abundant and consisted of mostly large individuals. *Balanophyllia elegans* were moderately abundant with many large individuals present. *Urticina lofotensis* were common and mostly large. Mysid shrimp, which were so thick last year it was difficult to see the bottom, were noticeably absent. All sites on the south side of Santa Rosa Island had an abundance of mysids last year. Tunicates were moderately abundant and diverse. *Styela montereyensis* were common with all sizes present. *Crassedoma gigantea* were rare and mostly small. *Cypraea spadicea* were common with several out in the open. One *Haliotis rufescens* was observed. *Megathura crenulata* were common and mostly large. The most common miscellaneous invertebrates sampled during RPCs were boring clams followed by *Paracyathus* sp. *Dermasterias imbricata* were moderately abundant and mostly large. *Pachythyone rubra* were common but patchy. They were mostly on a large rock near the 79 m mark. *Parastichopus parvimensis* were common and consisted of mostly large individuals. *Patiria miniata* were abundant with juveniles present but consisted of mostly medium to large individuals. *Pisaster giganteus* were abundant with juveniles present but consisted of mostly medium to large Individuals. *Strongylocentrotus franciscanus* were moderately abundant, large and healthy looking, and out in the open. *Strongylocentrotus purpuratus* were common, with juveniles present. They were notably less abundant than the last three years and were confined to crevice habitat.

Site #24, Chickasaw, Santa Rosa Island

2013 status: Mature kelp forest

Sampling Dates and Work Completed

07/17/13: Fish transects, video transects, roving diver fish counts, fish size frequencies, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Patiria miniata, Pisaster giganteus, Pycnopodia helianthoides, Crassedoma giganteus, Megathura crenulata, Tethya aurantia, Haliotis rufescens* and *Macrocystis pyrifera* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

Overall this site was similar to past years. This year it was a mature kelp forest with large, widely spaced plants. There were few subadult plants present at the site. Canopy cover of *Macrocystis pyrifera* was estimated at 75%. There seemed to be less understory algae than last year and a bit more scoured or low light conditions on the bottom. The tops of the rocks were covered with red algae, although a little less than last year, that consisted of *Callophyllis* sp. and similar reds. There seemed

to be more crevices filled with red urchins than last year, and most of the urchins remained in or near crevices. Most of the *S. purpuratus* were located under the spine canopies of *S. franciscanus*. *Urticina lofotensis* were common and mostly large. The most common miscellaneous invertebrate recorded during RPCs were *Cucumaria* spp., followed by hydroids. *Parastichopus parvimensis* were common and notably large.

Site #25, South Point, Santa Rosa Island

2013 status: Mature kelp forest

Sampling Dates and Work Completed

07/16/13: Fish transects, video transects, fish size frequencies, roving diver fish counts, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Lytechinus anamesus, Patiria miniata, Pisaster giganteus, Pycnopodia helianthoides, Megastraea undosa, Lithopoma gibberosa, Crassedoma giganteus, Tegula regina, Megathura crenulata, Kelletia kelletii, Lophogorgia chilensis, Muricea californica, Muricea fruticosa, Tethya aurantia, Haliotis rufescens* and *Macrocystis pyrifera* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

Cystoseira spp. were moderately abundant and patchy. Canopy cover of *Macrocystis pyrifera* was estimated at 80%. *Polymastia pacifica* were notably abundant, similar to past years. *Pycnoclavella stanleyi* were abundant. *Polyclinum planum* were notably abundant, similar to past years and was present on all the flat areas of the transect. *Styela montereyensis* were common with all sizes present. *Haliotis rufescens* were common and mostly large with many very large individuals present. *Megastraea undosa* were rare with several very large individuals present, similar to past years. *Cucumaria* spp. were abundant and carpeted much of the site, similar to last year. Most common miscellaneous invertebrates recorded during RPCs were hydroids, followed by anemones. *Parastichopus parvimensis* were rare with all individuals observed being large. *Patiria miniata* were moderately abundant with all sizes present. *Pycnopodia helianthoides* were moderately abundant and consisted of medium to large individuals. *Strongylocentrotus franciscanus* and *S. purpuratus* were moderately abundant and were out in the open more than in past years. Both species appeared more abundant than in past years and since monitoring began in 2005. One male *Hexagrammos decagrammus* was observed.

Site #26, Devil's Peak Member, Santa Cruz Island

2013 status: Dominated by Strongylocentrotus spp.

Sampling Dates and Work Completed

06/10/13: Fish transects, fish size frequencies, video transects, roving diver fish counts, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Patiria miniata, Pisaster giganteus, Pycnopodia helianthoides, Megastraea undosa, Lithopoma gibberosa, Crassedoma giganteus, Tegula regina, Megathura crenulata, Lophogorgia chilensis, Muricea californica, Tethya aurantia* and *Haliotis rufescens* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

The site appeared similar to recent years, devoid of macroalgae except for the tops of larger rocks. No canopy cover was present. *Strongylocentrotus* spp. continued to be moderately abundant although the bottom was not completely barren. Red algae, consisting mostly of *Laurencia* sp., were present throughout the site. The tops and sides of larger rocks had moderate cover of bryozoans, invertebrates and sponges. *Tethya aurantia* was moderately abundant and all sizes were present. Many were covered in diatom film. *Corynactis californica* were common and many looked unhealthy. *Diopatra ornata* were common in the appropriate habitat. *Panulirus interruptus* were rare with only one legal sized individual observed at the site. *Aplysia californica* were common and mostly large. *Crassedoma gigantea* were common and mostly large. Two juvenile *Haliotis rufescens* were observed in quadrats and measured at 39 and 46 mm. *Kelletia kelletii* were rare with one juvenile observed. *Lithopoma gibberosa* were rare and several small (~50 mm) individuals were measured for size frequencies. *Megastraea undosa* were common and mostly large, but juveniles were present. *Tegula regina* were common and all were about 50 mm in size. The most common miscellaneous invertebrates on RPCs were barnacles and *Spirobranchus spinosus*. *Pachythyone rubra* were rare and mostly found in patches on large rocks. One *Parastichopus californicus* was observed. *Parastichopus parvimensis* consisted of mostly large individuals and were relatively abundant for non-MPA site, similar to last year. *Pisaster giganteus* were common with all sizes present. *Pycnopodia helianthoides* were common and all individuals were large. Juvenile *Strongylocentrotus purpuratus* and *S. franciscanus* were rare. *Alloclinus holderi* were rare although one diver observed six large individuals.

Site #27, Potato Pasture, Santa Cruz Island

2013 status: Dominated by Strongylocentrotus purpuratus

Sampling Dates and Work Completed

08/28/13: Fish transects, video transects, roving diver fish counts, fish size frequencies, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Lytechinus anamesus, Patiria miniata, Pisaster giganteus, Megastraea undosa, Lithopoma gibberosa, Crassedoma giganteus, Tegula regina, Megathura crenulata, Kelletia kelletii, Lophogorgia chilensis, Tethya aurantia* and *Macrocystis pyrifera* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

Other than the notable increase in *Pachythyone rubra* from 0–25 meters on the offshore side of the transect area, there was not much difference from recent years. The tops of the largest rocks and parts of the reef were mostly covered with dense, mature *Eisenia arborea* and an abundance of understory algae. No canopy cover was present. *Desmarestia* spp. were common mostly from meters 0–15 and had a thick cover on the bottom. *Eisenia arborea* adults were common and juveniles were more abundant than in past years, mostly on the tops of large rocks. *Sargassum horneri* were common mostly from meters 0–15 on the offshore side of the transect. However, some were scattered around the onshore side, either in low lying areas or on the tops of boulders. All of these were less than 5 cm. Only two adult, reproductive plants were observed; one approximately 20 cm tall and the other

70 cm. These two plants were senescing. *Tethya aurantia* were common and mostly small to medium in size. *Corynactis californica* were common and looked rather unhealthy. *Lophogorgia chilensis* were common and occurred mostly on the deep side of the transect. *Aglaophenia struthionides* were common and were unhealthy looking and covered with diatoms. The most abundant miscellaneous invertebrates recorded during RPCs were barnacles and *Spirobranchus spinosus*. Miscellaneous invertebrates were moderately abundant and occurred mostly on the high relief areas. *Aplysia californica* were common, and most were small. *Crassedoma gigantea* were common, with all sizes present. Some were notably large. Their abundance has declined over the last two years. *Lytechinus anamesus* were rare and all small with only seven observed. *Pachythyone rubra* were more abundant than has ever been observed at this site and were located mostly from 0–25 m, covering rocks and on *Desmarestia* spp. They were also abundant offshore of the transect. *Parastichopus californicus* were rare and mostly large. *Patiria miniata* were common with all sizes present. Inshore of the transect two two-year old *Hypsypops rubicundus* were observed. *Lythrypnus dalli* recruits approximately 2 cm were observed, and most likely recruited this year. We observed the first *Paralabrax clathratus* recruits of the year. Two *Gymnothorax mordax* were observed.

Site #28, Cavern Point, Santa Cruz Island

2013 status: Kelp forest

Sampling Dates and Work Completed

09/18/13: Fish transects, video transects, roving diver fish counts, fish size frequencies, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Patiria miniata, Pisaster giganteus, Megastraea undosa, Lithopoma gibberosa, Crassedoma giganteus, Tegula regina, Megathura crenulata, Kelletia kelletii, Lophogorgia chilensis, Muricea californica, Tethya aurantia* and *Macrocystis pyrifera* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

Similar to last year, this site was a kelp forest. However, there appeared to be more subadult *Macrocystis pyrifera* then last year; most of the *M. pyrifera* at the site were young/small. Also, there was an abundance of understory algae such as *Eisenia arborea* and red algae. There were high density patches of *Strongylocentrotus purpuratus* scattered throughout the site and also concentrated at the 100 m end of the transect, which was mostly barren of macroalgae from 90–100 m. *Strongylocentrotus purpuratus* has continued to increase in size since the site was established in 2005. There has also been recent recruitment in 2011 and 2012. *Sargassum horneri* juveniles were moderately abundant at the site while adults were rare. Only about 15 reproductive adults were observed and all those were less than 25 cm in height. *Gelidium* spp. were common on the tops of large rocks. *Panulirus interruptus* were common but were notably fewer and smaller than last year. The most common miscellaneous invertebrates recorded during RPCs were barnacles, followed by *Cucumaria* spp. *Aplysia californica* were rare and all individuals were small. One fresh *Haliotis rufescens* shell was observed. Adult and juvenile *Centrostephanus coronatus* were rare with one small juvenile observed. *Pisaster giganteus* were common with at least ten observed. One *Parastichopus parvimensis* appeared to have wasting disease. It was a medium sized individual that

appeared darker than usual and had a white patch about one inch in diameter. Four *Lythrypnus dallii* were observed. Two *Gymnothorax mordax* were observed on the offshore side of the transect.

Site #29, Little Scorpion, Santa Cruz Island

2013 status: Dominated by Strongylocentrotus spp.

Sampling Dates and Work Completed

06/14/13: Fish transects, video transects, fish size frequencies, roving diver fish counts, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Lytechinus anamesus, Patiria miniata, Pisaster giganteus, Megastraea undosa, Lithopoma gibberosa, Crassedoma giganteus, Tegula regina, Megathura crenulata, Kelletia kelletii* and *Tethya aurantia* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

Overall the site was similar to last year. No kelp canopy was present. Perhaps the most notable change was the increase of *Laurencia pacifica*, similar to Keyhole on Anacapa island. Other red algae were common and consisted mostly of *Laurencia pacifica*. *Tethya aurantia* were common with all sizes present. *Panulirus interruptus* were rare with one less than legal size individual observed. *Megathura crenulata* were common with all sizes present. The most common miscellaneous invertebrates observed during RPCs were *Spirobranchus spinosus,* followed by barnacles. Urchin wasting disease was observed in 3% of *Strongylocentrotus franciscanus* and 1% of *S. purpuratus*; notably more wasting disease than has been observed elsewhere as of this date. *Lythrypnus dalli* were rare with four observed near the 100 m end of the transect. *Coryphopterus nicholsii* were moderately abundant and all sizes were present. No *Alloclinus holderi* were observed at the site. One *Ophiodon elongates* was observed.

Site #30, Pedro Reef, Santa Cruz Island

2013 status: Dominated by Strongylocentrotus spp.

Sampling Dates and Work Completed

07/15/13: Fish transects, fish size frequencies, video transects, roving diver fish counts, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Lytechinus anamesus, Patiria miniata, Pisaster giganteus, Megastraea undosa, Lithopoma gibberosa, Crassedoma giganteus, Tegula regina, Megathura crenulata, Kelletia kelletii, Lophogorgia chilensis, Muricea californica, Muricea fruticosa, Tethya aurantia* and *Macrocystis pyrifera* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

This site was similar to past years and was mostly devoid of macroalgae with the exception of the shallow rocks inshore of meter 25. No kelp canopy was present. Adult *Eisenia arborea* were rare but juveniles were common and scattered around the site. *Macrocystis pyrifera* were rare and only observed on the shallow rocks around meter 25. *Tethya aurantia* were common with all sizes present. They were difficult to see because most were covered in diatom film. *Corynactis californica* were

abundant, similar to recent years. Some appeared unhealthy. *Balanus* sp. were moderately abundant, similar to last year although larger. *Cancer* spp. crabs were common with at least four observed. No *Panulirus interruptus* were observed although three molts were found. Miscellaneous invertebrates were common and there were many unidentified worm mats throughout the site. The most common miscellaneous invertebrates recorded during RPCs were barnacles. All sizes of *Aplysia californica* were present and egg masses were observed. *Crassedoma gigantea* were common with all sizes present, similar to past years. Individuals were most abundant on the shallow reef bowl inshore of meter 25. *Lithopoma gibberosa* were rare and all observed were less than 50 mm. *Megastraea undosa* were common and mostly small with one large individual observed. *Megathura crenulata* were mostly small although all sizes were present. Larger individuals appeared unhealthy. *Bursa californica* were common. Sea urchin wasting disease was observed on less than 1% of *Strongylocentrotus franciscanus* and *S. purpuratus*. *Lytechinus anamesus* were present in all sizes with some very small individuals also observed. *Ophiothrix spiculata* were moderately abundant and mostly located on the offshore side of the transect. *Pachythyone rubra* were rare with only a few observed at the site. *Parastichopus parvimensis* were common and mostly medium to large in size. *Pisaster ochraceus* were common and more abundant than last year. *Lythrypnus dalli* were rare with at least seven observed. *Alloclinus holderi* were rare with only one observed at the site. *Oxyjulis californica* YOY were observed. This is the first sighting for the 2013 KFM season. One juvenile *Regalecus* sp., oarfish, was observed near the dive step and was approximately 10 cm in length. The lobster trap that was present at the 100 m end of the transect last year was still present. Bird bones were still present near the trap as well, possibly the same bird bones from last year.

Site #31, Keyhole, Anacapa Island

2013 status: Dominated by Strongylocentrotus purpuratus

Sampling Dates and Work Completed

06/13/13: Fish transects, video transects, roving diver fish counts, fish size frequencies, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Lytechinus anamesus, Patiria miniata, Pisaster giganteus, Megastraea undosa, Crassedoma giganteus, Tegula regina, Megathura crenulata, Kelletia kelletii, Lophogorgia chilensis, Muricea californica, Muricea fruticosa,* and *Tethya aurantia* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

This site appeared to be a bit different from last year, but it was difficult to pinpoint the changes. Perhaps the change was a notable increase in the abundance of *Laurencia pacifica* that has been moderately abundant at many of the sites this year. The site continued to be dominated by *Strongylocentrotus purpuratus*. No kelp canopy was present. The most abundant algae at the site were *Laurencia pacifica*, similar to other sites. *Desmarestia* spp. were rare and mostly small. Only one adult *Laminaria farlowii* was observed at the site. No *Sargassum horneri* were observed at the site. A subsequent dive was made inshore of the transect where it was abundant several years ago and none were observed. *Tethya aurantia* were rare with only five observed. *Muricea californica* were common and mostly large. At meter 21 on the offshore side of the transect, the large colony of

Parazoanthus lucificum continued to persist and appeared healthy. *Haliotis rufescens* were not observed on the site, although inshore of the site under a rock one 20 mm individual was observed. *Megathura crenulata* were rare and small to medium in size with no large individuals observed, similar to last year. The most common miscellaneous invertebrates observed during RPCs were *Eugorgia rubens* and *Spirobranchus spinosus*. *Centrostephanus coronatus* recruits from last year were common. Urchin wasting disease was observed in less than 1% of *Strongylocentrotus purpuratus* and *S. franciscanus*. *Lytechinus anamesus* juveniles were common and should be noted that the small ones were very cryptic and covered in debris or large gravel sand. We believe that many of these were missed by the band transect observers and that these could be considered non-emergent which the KFM protocols are not designed to sample. *Parastichopus parvimensis* were moderately abundant with all sizes present. *Patiria miniata* were common and mostly small. *Pisaster giganteus* were rare and mostly large. *Alloclinus holderi* were common and most were large. They appeared notably more common after the RDFC was completed. This is the most individuals we have observed at any site this year. There was a large aggregation of male and female *Semicossyphus pulcher*. At least five males and over 25 females were observed. *Paralabrax clathratus* were moderately abundant and large. Recruits (9–13 cm) from last year were common. There was a large aggregation of over 60 individuals (all large than 35 cm) inshore of the transect. *Caulolatilus princeps* were abundant with over 50 observed ranging in sizes from 30–75 cm.

Site #32, East Fish Camp, Anacapa Island

2013 status: Dominated by Strongylocentrotus spp. and Ophiothrix spiculata

Sampling Dates and Work Completed

05/30/13: Fish transects, video transects, roving diver fish counts, fish size frequencies, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Lytechinus anamesus, Patiria miniata, Pisaster giganteus, Pycnopodia helianthoides, Megastraea undosa, Lithopoma gibberosa, Crassedoma giganteus, Tegula regina, Megathura crenulata, Kelletia kelletii, Tethya aurantia,* and *Macrocystis pyrifera* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

The site remained dominated by echinoderms with *Ophiothrix spiculata* being the most dominate, followed by *Strongylocentrotus purpuratus* and *S. franciscanus*. No kelp canopy was present. Overall this site was similar to recent years, except for a patch of adult and subadult *Macrocystis pyrifera* and other adult plants located throughout the transect. The adult plants had relatively small holdfasts with a high number of stipes. The stipes on these plants were notably thin. Nearly all *M. pyrifera* holdfasts had large numbers of sea urchins feeding on them. It appeared that these plants would not survive very much longer. Other red algae consisted of mostly *L. pacifica*. Diatoms were also moderately abundant and covered much of the *L. pacifica*. *Sargassum horneri* was rare with one very large reproductive individual observed at meter 41. *Corynactis californica* were notably more abundant and appeared larger, healthier and more robust than last year. We believe that they may be gradually increasing in recent years. Amphipod tube mats were common in the rocky areas. *Cancer* spp. were rare overall but at least five individuals were observed. This is an unusually high number for

Anacapa Island. *Aplysia californica* were common and all sizes were present, including very tiny ones. *Megathura crenulata* were common and most were very small and tucked back into cracks and crevices. Miscellaneous invertebrates on RPCs consisted mainly of *Chaetopterus* sp., anemones and amphipod tube mats. Overall, miscellaneous invertebrate cover was rare. *Lytechinus anamesus* were common while juveniles were rare and patchy in the low-lying areas of the reef. At least two *Pisaster ochraceus* were observed. *Pycnopodia helianthoides* were rare with only one observed. *Strongylocentrotus purpuratus* were moderately abundant with only several juveniles observed. Similar to all other sampled sites this year, juvenile *Sebastes mystinus* and *S. serranoides* dominated the site. *Coryphopterus nicholsii* were very abundant. One *Alloclinus holderi* and three *Caulolatilus princeps* were observed after the RDFC.

Site #33, Black Sea Bass Reef, Anacapa Island

2013 status: Dominated by Ophiothrix spiculata

Sampling Dates and Work Completed

08/26/13 : Fish transects, fish size frequencies, video transects, roving diver fish counts, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *Lytechinus anamesus, Megastraea undosa, Crassedoma giganteus, Tegula regina, Megathura crenulata, Tethya aurantia,* and *Macrocystis pyrifera* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

08/30/13: Size frequencies for *S. purpuratus, S. franciscanus, Patiria miniata, Pisaster giganteus, Lophogorgia chilensis, Muricea californica* and *Muricea fruticosa* were completed.

Site Notes

This site continues to be dominated by *Ophiothrix spiculata*, which remained near the record high cover recorded in 2012. They were several layers thick over much of the reef, making it difficult to monitor everything else. The band transect observers brushed them away as best they could. Also, *O. spiculata* were smaller than usual (perhaps recruitment event). *Strongylocentrotus* spp. were rare. No kelp canopy was present. Algae were scattered around the transect. On the east end of the reef there was a surprising diversity and amount of algae. *Sargassum horneri* was common with juveniles moderately abundant. It was patchy and mostly on the east end of the site and on top of the reef. The adults were between 50–100 cm, and all were unhealthy looking and senescing. The juveniles were patchy but often very dense. All of the juveniles were tiny (< 5 cm). This was the most common brown algae at the site. *Tethya aurantia* were common but difficult to see under the *O. spiculata*. *Corynactis californica* were common but in mostly small colonies. *Lophogorgia chilensis* were common and mostly unhealthy. Only 10 were observed. *Muricea californica* were rare with only three large individuals observed. *Muricea fruticosa* were also rare with only five observed. We measured all gorgonians on the site. David Kushner would expect them to increase if the *O. spiculata* were to disappear. *Panulirus interruptus* were moderately abundant and most were of legal size. *Bugula californica* were common and most colonies appeared unhealthy or dead. Other bryozoans were rare and most appeared unhealthy. *Megathura crenulata* were rare with only one small individual observed. *Centrostephanus coronatus* were common with at least eight small (18–22 mm) individuals observed. *Lytechinus anamesus* were rare with only one small individual observed.

Parastichopus parvimensis were moderately abundant but mostly small. *Patiria miniata* were rare with all sizes present. Both *Strongylocentrotus purpuratus* and *S. franciscanus* adults and juveniles were rare and were notably fewer than in recent years. Small groups of urchins (typically less than 20) were scattered around the transect. *Lythrypnus dalli* were rare with several juveniles observed. *Alloclinus holderi* were common and came out of crevice habitat later in the day. Michael Hoban recorded 19 male *Semicossyphus pulcher*, while his dive buddy James Grunden only observed 9 males. It is believed that the 19 sheephead count was due to double counting. They were swimming together the entire dive. This is a large discrepancy in counts. Michael Hoban is rated as an intermediate observer and James as an expert. The data are entered into the database as such. After the RDFC one *Seriola lalandi*, yellowtail, one small female *Halichoeres semicinctus*, and four small, *Stereolepis gigas*, giant black sea bass were observed in addition to those recorded on the RDFC. *Lythrypnus dalli* recruits less than 2 cm were also observed. The most common miscellaneous invertebrate recorded on RPCs was insignificant due to very low cover of this category.

Site #34, Lighthouse, Anacapa Island

2013 status: Dominated by Strongylocentrotus spp.

Sampling Dates and Work Completed

05/31/13: Fish transects, video transects, fish size frequencies and roving diver fish counts were completed.

08/16/13: $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Lytechinus anamesus, Patiria miniata, Pisaster giganteus, Pycnopodia helianthoides, Megastraea undosa, Lithopoma gibberosa, Crassedoma giganteus, Tegula regina, Megathura crenulata, Kelletia kelletii, Lophogorgia chilensis, Muricea californica, Muricea fruticosa* and *Tethya aurantia* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

Overall this site was similar to last year and continued to be dominated by *Strongylocentrotus purpuratus* and also had a moderate density of *S. franciscanus*. The site was nearly devoid of macroalgae. No kelp canopy was present. *Cystoseira* spp. was rare with only two plants observed on the tops of rocks. *Eisenia arborea* adults and juveniles were rare with only few observed growing on the tops of rocks or epiphytically on gorgonians. *Macrocystis pyrifera* were rare with only few juveniles observed growing on the tops of rocks or epiphytically on gorgonians. *Gigartina* spp. and *Gelidium* spp. were both rare and only observed on the tops of rocks. Bare rock was notably common at the site, similar to past years. *Anthopleura* spp. were common and located mostly at the 100 m end of the transect. *Corynactis californica* were moderately abundant and notably abundant on large rocks. *Parazoanthus lucificum* were rare with three colonies observed. The most common miscellaneous invertebrate recorded during RPCs were gorgonians. Tunicates in general were rare, though *Didemnum* sp. were common. *Aplysia californica* were common with all sizes present. Egg masses and mating aggregations were observed at the site. Some *A. californica* appeared pale and sick. *Megastraea undosa* were common with all sizes present. *Megathura crenulata* were common and mostly small to medium sized. *Octopus* spp. were rare with at least two observed. *Ophiothrix*

spiculata were more abundant than in past years and were located mostly on the offshore side of the site. *Parastichopus parvimensis* were common and mostly medium to large. *Pycnopodia helianthoides* were rare with only one observed. During our visit to this site on 8/16 we observed two large *Stereolepis gigas*, giant black sea bass. Juvenile *Oxyjulis californica and Chromis punctipinnis*, along with juvenile *Semicossyphus pulcher* (~7 cm), *Hypsypops rubicundus* and *Scorpaenichthys marmoratus*, cabezon were also observed at the site. Juvenile *Oxylebius pictus* were common. Approximately three-quarters of all *Oxylebius pictus* observed were juveniles. Two abandoned lobster traps were found on the transect. Both had metal clips which prevented the trap from self-destructing. The diver who initially found the traps could not even pry the trap door open. Two large sheep crabs, *Loxorhynchus grandis*, and one *Embiotoca jacksoni* were eventually freed from the traps.

Site #35, Webster's Arch, Santa Barbara Island

2013 status: Dominated by Strongylocentrotus purpuratus and Ophiothrix spiculata

Sampling Dates and Work Completed

05/15/13: Fish transects, video transects, roving diver fish counts, fish size frequencies, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Patiria miniata, Pisaster giganteus, Pycnopodia helianthoides, Megastraea undosa, Lithopoma gibberosa, Crassedoma giganteus, Tegula regina, Megathura crenulata, Tethya aurantia,* and *Macrocystis pyrifera* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

Overall this site was similar to recent years. *Ophiothrix spiculata* dominated the low-lying areas of the reef and the tops of the high relief ridges on the 60–100 m section of the transect. *Strongylocentrotus purpuratus* dominated over the entire reef, but their abundance was varied over the site. No kelp canopy was present. Over the site there was an abundance of encrusting invertebrates, and a higher concentration of algae this year. This consisted of miscellaneous reds algae, *Desmarestia* spp., and some adult and juvenile *Eisenia arborea*. There were only two adult *Macrocystis pyrifera* plants, and juveniles were scattered about the site. *Codium setchellii* continued to be moderately abundant and there was also a small amount of *C. fragile* present. *Stylaster californicus* were rare with one observed on band transects. The size was estimated for size frequencies. One was also observed last year. *Balanus* spp. were common and located in patches. *Panulirus interruptus* were rare with two observed. Miscellaneous invertebrates were diverse and common. *Myxicola* sp. were present, but notably less abundant. The misc. invertebrates category on RPCs consisted of mostly barnacles and hydroids. One fresh *Haliotis corrugata* and one fresh *H. rufescens* shells were observed. *Kelletia kelletii* were rare with only two observed. *Lithopoma gibberosa* adults were common and juveniles were moderately abundant. It should be noted that last year we observed several < 10 mm *L. gibberosa* which indicated a notable recruitment event. This year small < 25 mm individuals were more abundant than David Kushner had ever seen. *Megastraea undosa* adults were common and juveniles were moderately abundant. This species is exhibiting a similar recruitment scenario to *L. gibberosa* as mentioned above. These are some of the highest

concentrations we have ever seen and should be noted that *Megastraea undosa* is a warmer water species and *L. gibberosa* is a colder water species. *Tegula regina* were moderately abundant with high variability in sizes. *Centrostephanus coronatus* were rare with several < 15 mm individuals observed, indicating a possible recent recruitment from last year's warm water event. *Lytechinus anamesus* were rare and notably tiny, similar to previous years. *Parastichopus parvimensis* were rare with possibly less than 30 at the site. *Pycnopodia helianthoides* were rare with only two large individuals observed. *Strongylocentrotus purpuratus* adults were moderately abundant and mostly small with some areas having high densities. Juveniles were rare. *Strongylocentrotus franciscanus* were common with all sizes present. There was an incredible abundance of juvenile *Sebastes* spp., and a general consensus that most were *S. mystinus*. Small *Chromis punctipinnis* were moderately abundant, likely from last year's recruitment. *Alloclinus holderi* was rare with only one large individual observed.

Site #36, Graveyard Canyon, Santa Barbara Island

2013 status: State of Transition

Sampling Dates and Work Completed

05/16/13: Fish transects, video transects, roving diver fish counts, fish size frequencies, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Patiria miniata, Pisaster giganteus, Megastraea undosa, Crassedoma giganteus, Lophogorgia chilensis, Muricea californica, Muricea fruticosa, Tethya aurantia,* and *Macrocystis pyrifera* were completed. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

Site Notes

Canopy cover of *Macrocystis pyrifera* was estimated at 20%. Adult *M. Pyrifera* plants were common and appeared healthy. Most mature plants were located near the 100 m end of the transect. *Cystoseira* spp. were rare and possibly observed for the first time at this site since sampling began in 2005. *Sargassum muticum* was moderately abundant with more large reproductive plants present this year. *Sagartia*/*Cactosoma* spp. were moderately abundant and blanketed some areas of the site. A wide range of sizes were present with some being notably large for this species. *Lophogorgia chilensis* were common and unhealthy looking with many individuals being smothered by *Ophiothrix spiculata*. *Chaetopterus* sp. was common. Other bryozoans consisted mostly of *Bugula* sp. and *Membranipora* sp. Not many molluscs were present. Overall, echinoderms have decreased at this site compared to last year. *Ophiothrix spiculata* were moderately abundant though less abundant than last year. This is probably the result of the physical removal by *Desmarestia* spp. that covered the site along with the swell action. No sea urchin or sea star wasting disease was observed. Fish were more abundant and diverse than have been previously observed at this site. Juvenile *Sebastes* spp. were abundant and consisted of at least five species. Most of the juvenile *Sebastes* spp. observed were *S. serranoides*, while *S. mystinus* were rare. Whereas at Webster's Arch, *S. mystinus* were common and *S. serranoides* were rare. Juvenile *Paralabrax clathratus* were observed. Juvenile *Oxyjulis californica* were recorded but were identified as recruits from the previous year. Juvenile *Scorpaenichthys marmoratus* were abundant, similar to other Santa Barbara Island sites.

Site #37, Southeast Reef, Santa Barbara Island

2013 status: Mature kelp forest

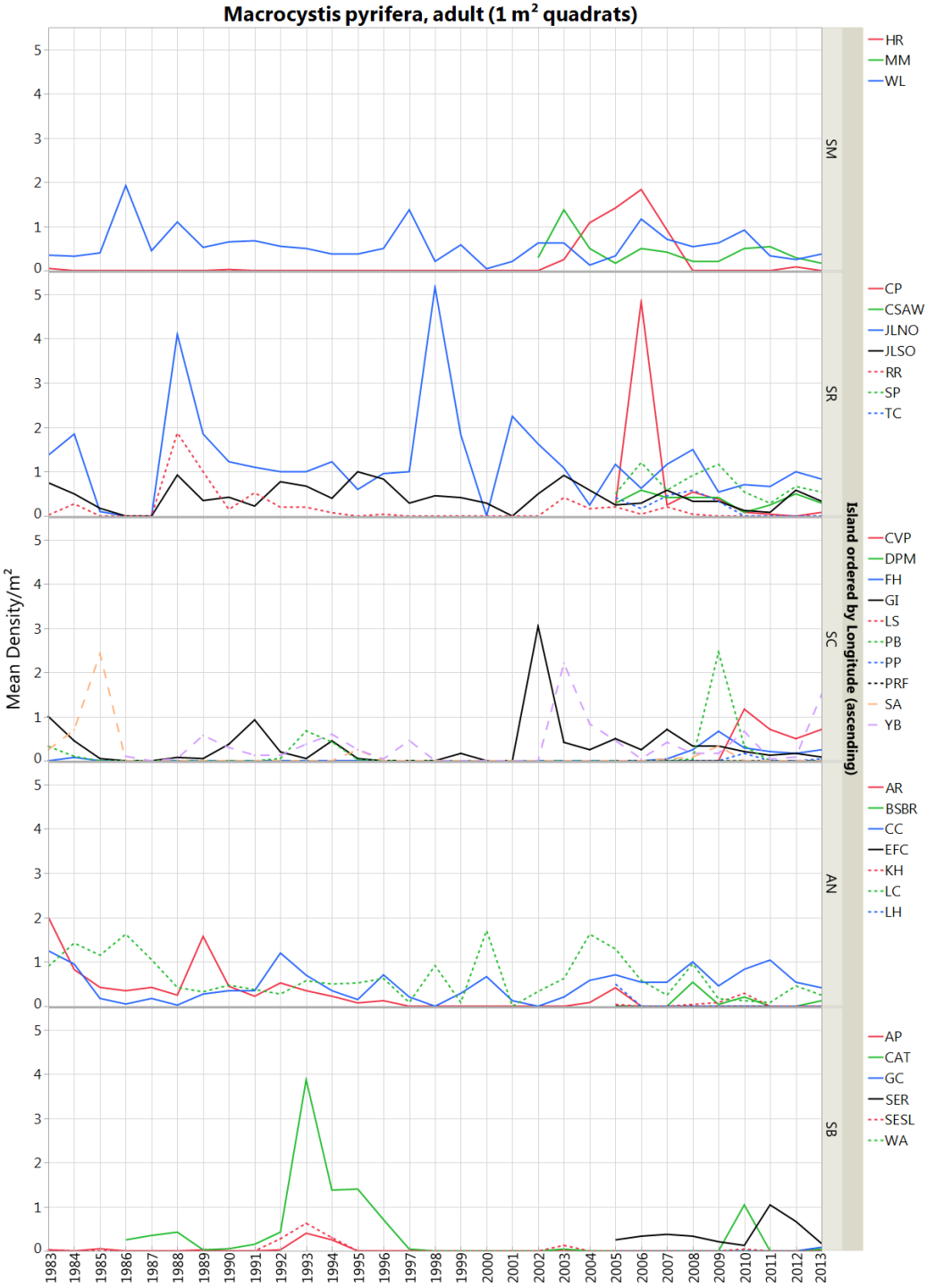
Sampling Dates and Work Completed

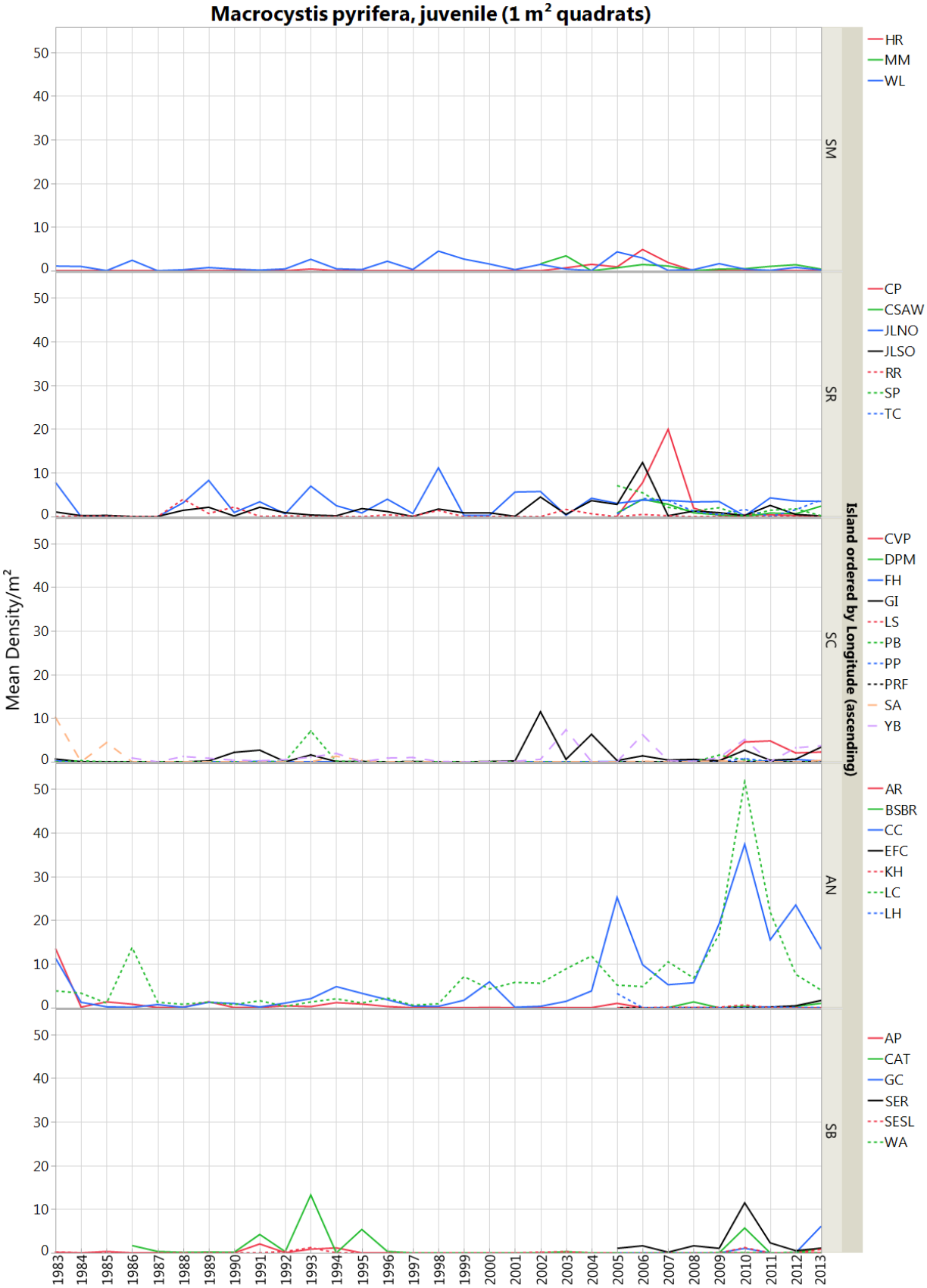
06/11/13: Fish transects, video transects, fish size frequencies, roving diver fish counts, $1m^2$ quadrats, $5m^2$ quadrats, band transects, random point contacts and size frequencies for *S. purpuratus, S. franciscanus, Pisaster giganteus, Megastraea undosa, Lithopoma gibberosa, Crassedoma giganteus, Tegula regina, Megathura crenulata, Tethya aurantia,* and *Macrocystis pyrifera* were completed. Sampling of all 3 ARMs were conducted. The temperature loggers were retrieved and deployed, and all data were successfully downloaded.

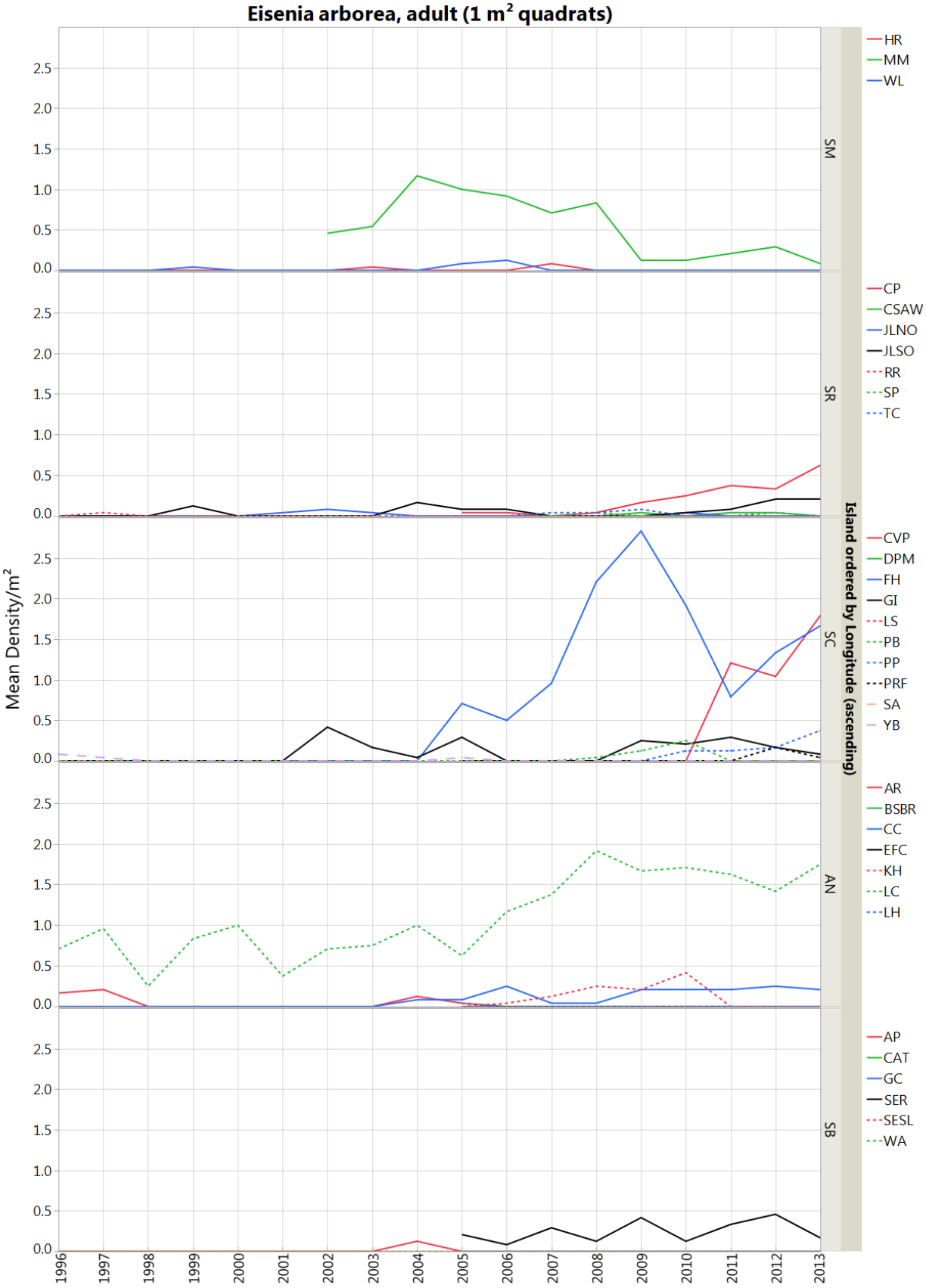
Site Notes

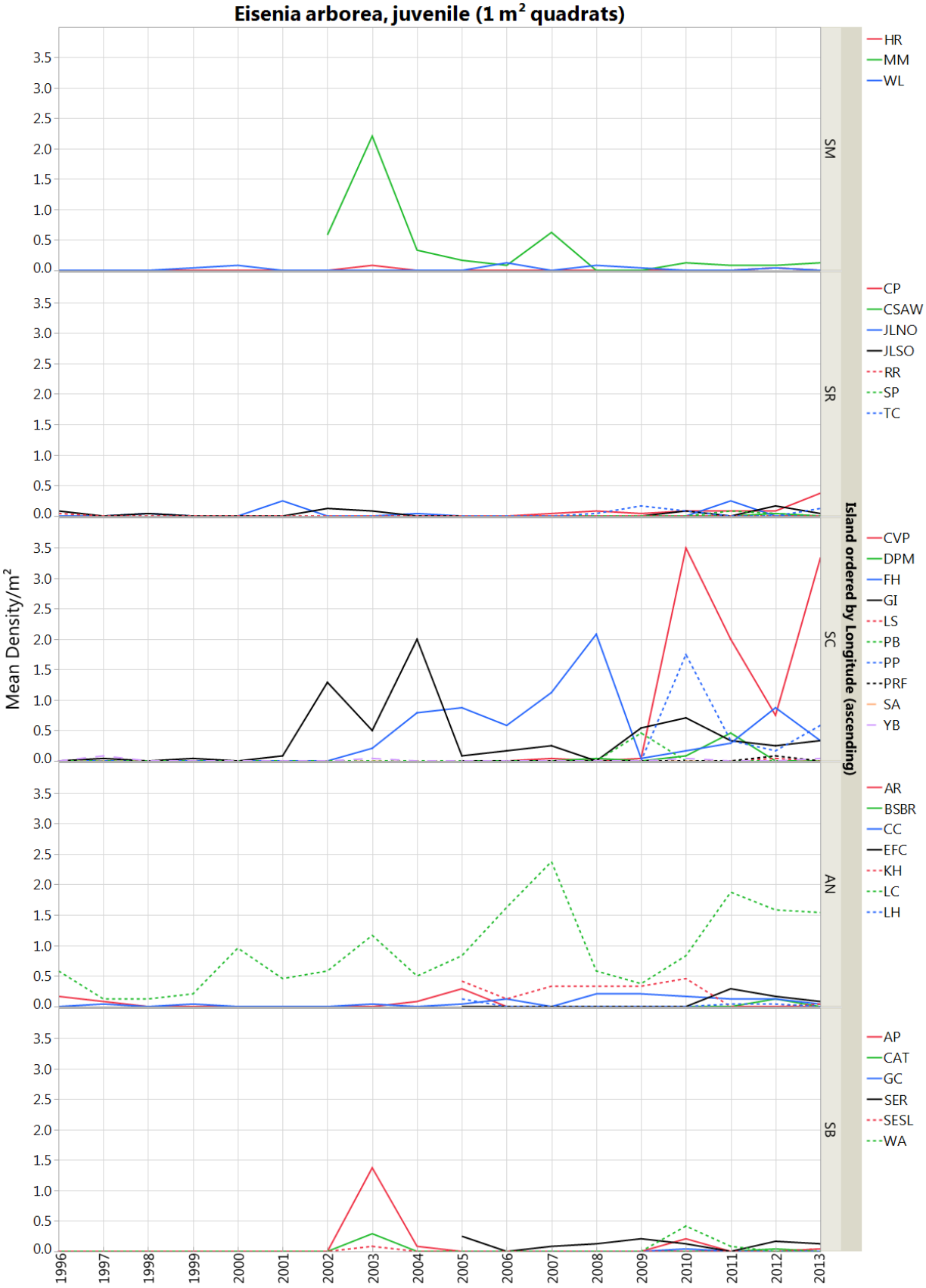
The site remains a kelp forest and continues to mature with large, widely spaced *Macrocystis pyrifera* plants. Canopy cover was estimated at 60%. Density of *M. pyrifera* appeared to have decreased from last year, which is expected as kelp forests mature. All plants appeared healthy. The first 60 m of the transect had notably less understory algae then we had previously seen. There were very few sub adult *M. pyrifera* plants with nearly all plants being notably large with large stipe counts and large holdfasts. There was also a moderate number of what looked like healthy holdfasts that had the stipes irregularly ripped off at the bottom, perhaps by large swell. These plants looked like they would have formed surface canopy. On our last visit to Santa Barbara Island on May 13th, it looked like the canopy cover was 100% over this site. One adult *Pterygophora californica* was observed. Other brown algae were common and consisted mostly of *Dictyota/ Pachydictyon*. *Gigartina* spp. were rare with several observed. *Panulirus interruptus* were common with fewer observed than last year. Bryozoans were abundant and consisted mostly of *Bugula* sp. The most abundant miscellaneous invertebrate in this category on RPCs were hydroids, followed by anemones. *Macrocystis pyrifera* were covered with a moderate amount of *Membranipora* sp., similar to Cat Canyon. *Crassedoma gigantean* were common with all sizes present, but consisted of mostly juveniles. No fresh *Haliotis* spp. shells were observed. *Lithopoma gibberosa* were rare and those observed were mostly of medium size. *Megastraea undosa* were common with all sizes present. *Megathura crenulata* were rare and consisted of mostly medium and large individuals. *Strongylocentrotus franciscanus* were moderately abundant and present out in the open with juveniles located under the spine canopy. Adults were large and appeared healthy. *Strongylocentrotus purpuratus* were also common but confined to crevice habitat. *Parastichopus parvimensis* were rare and present in a wide range of sizes. No sea urchin wasting disease was observed. Only one small *Patiria miniata* was observed on the site. *Pisaster giganteus* were common and mostly large. *Alloclinus holderi* were rare and mostly large although small individuals were observed. At least three *Gymnothorax mordax*, California moray eels, were present. Three ARMs were sampled for the first time at this site. These modules were installed at the end of the last sampling season. ARMs were completely covered with *Membranipora* sp. *Crassedoma gigantea* juveniles were notably abundant in the ARMS and were one of the most common species in the modules. In past ARMs deployment it seems to take the modules one to two years to normalize to their surrounding areas.

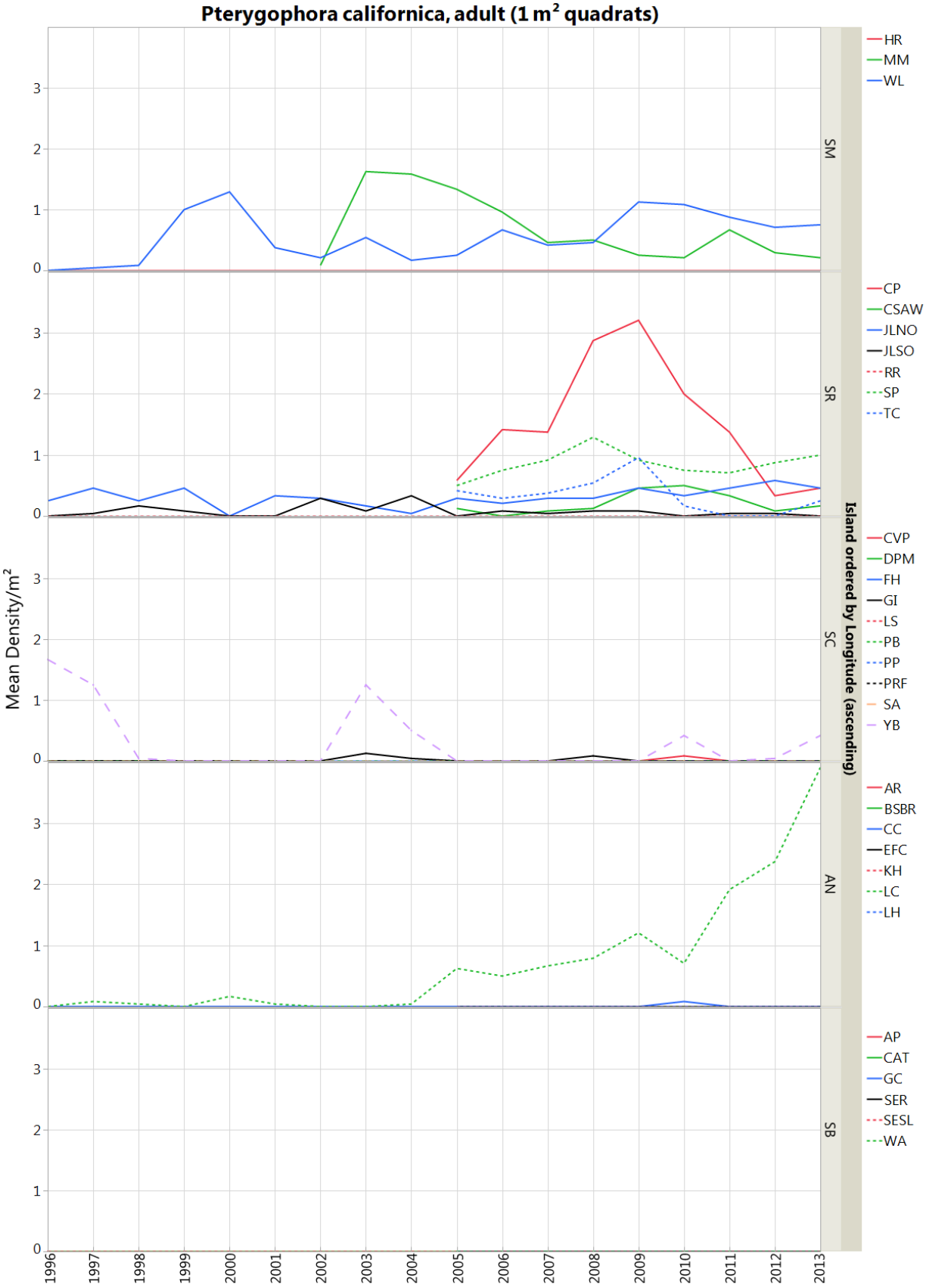
Appendix E. 1 Meter Quadrat Data

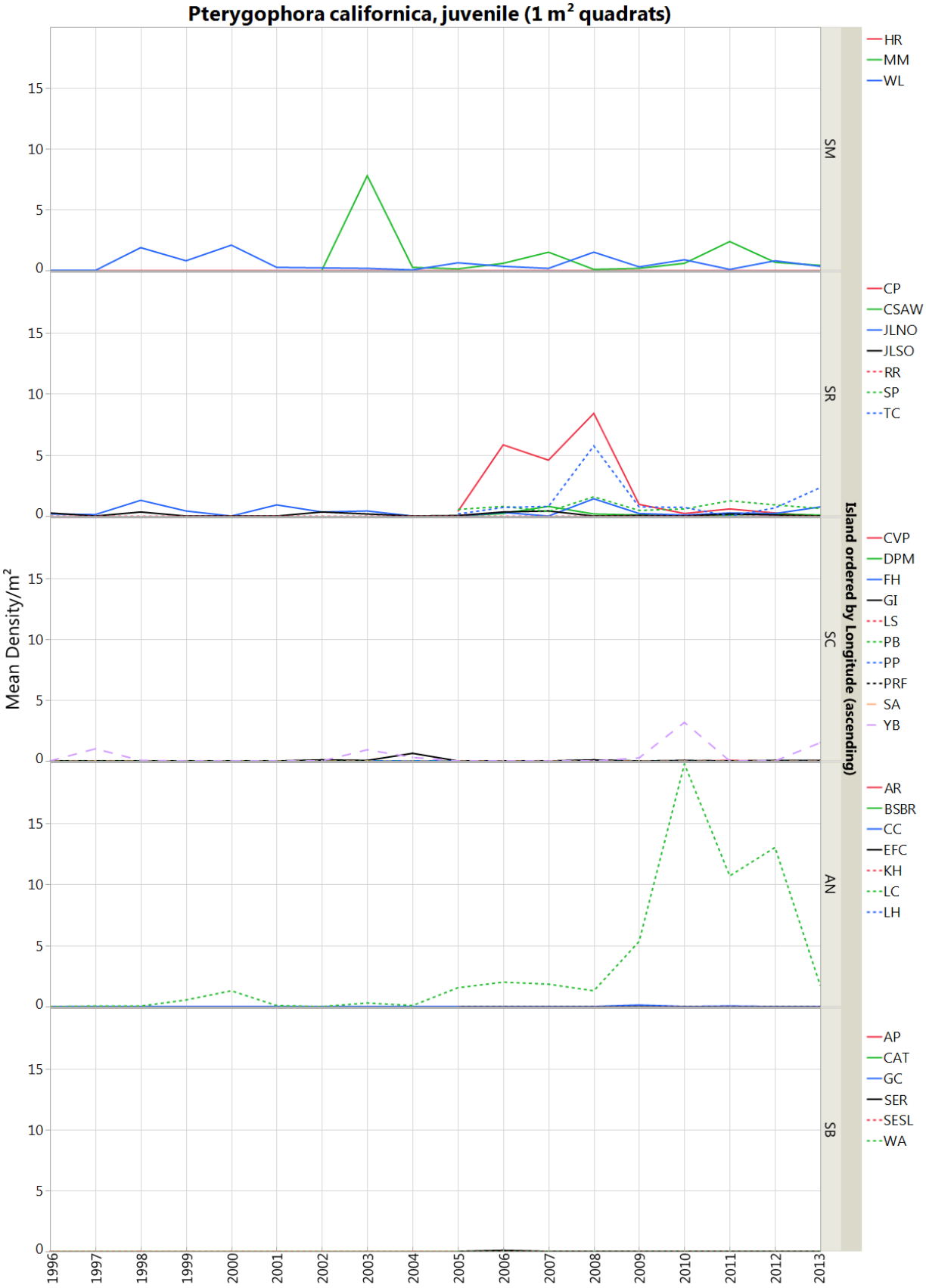


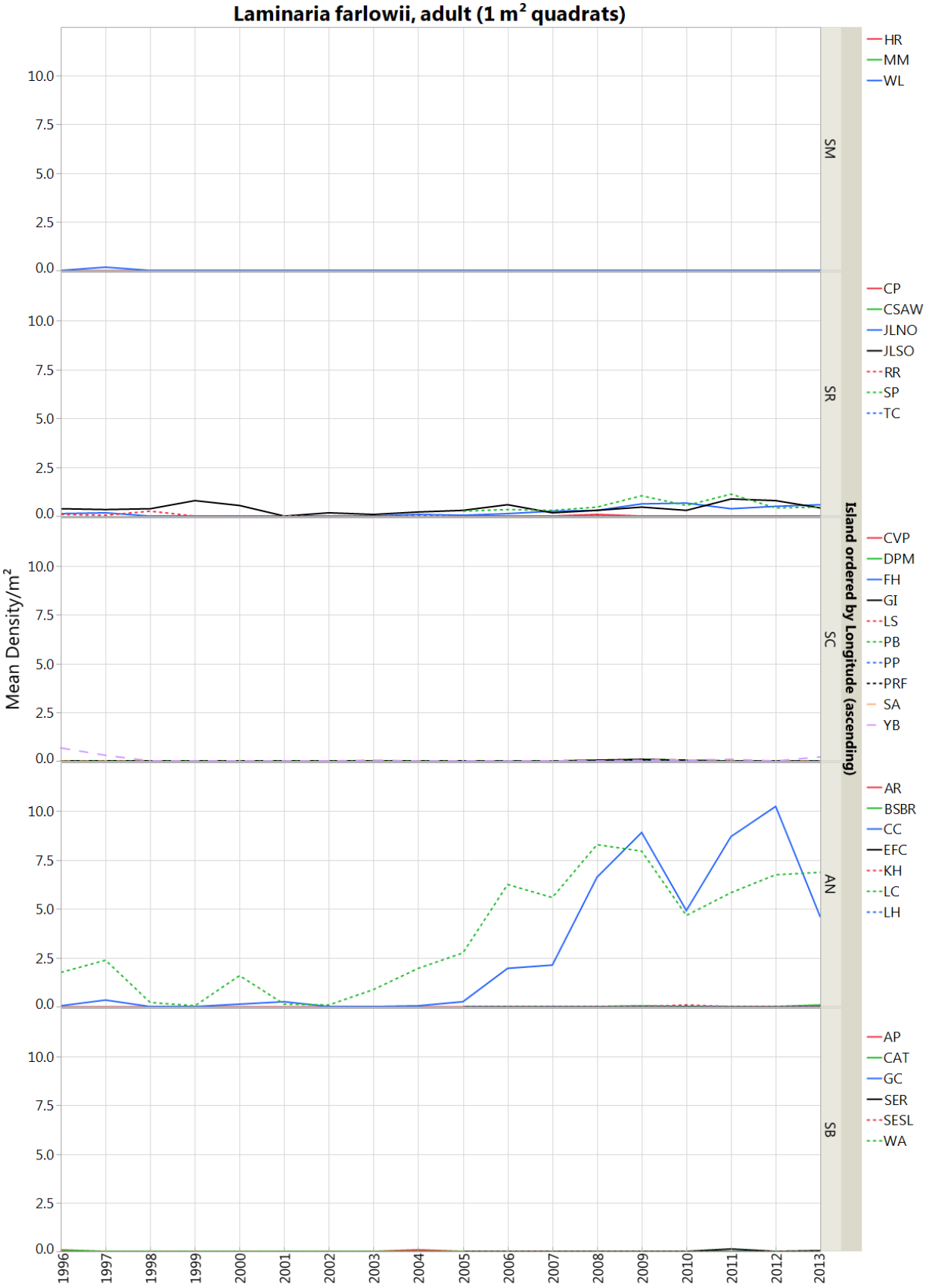

Macrocystis pyrifera, juvenile (1 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
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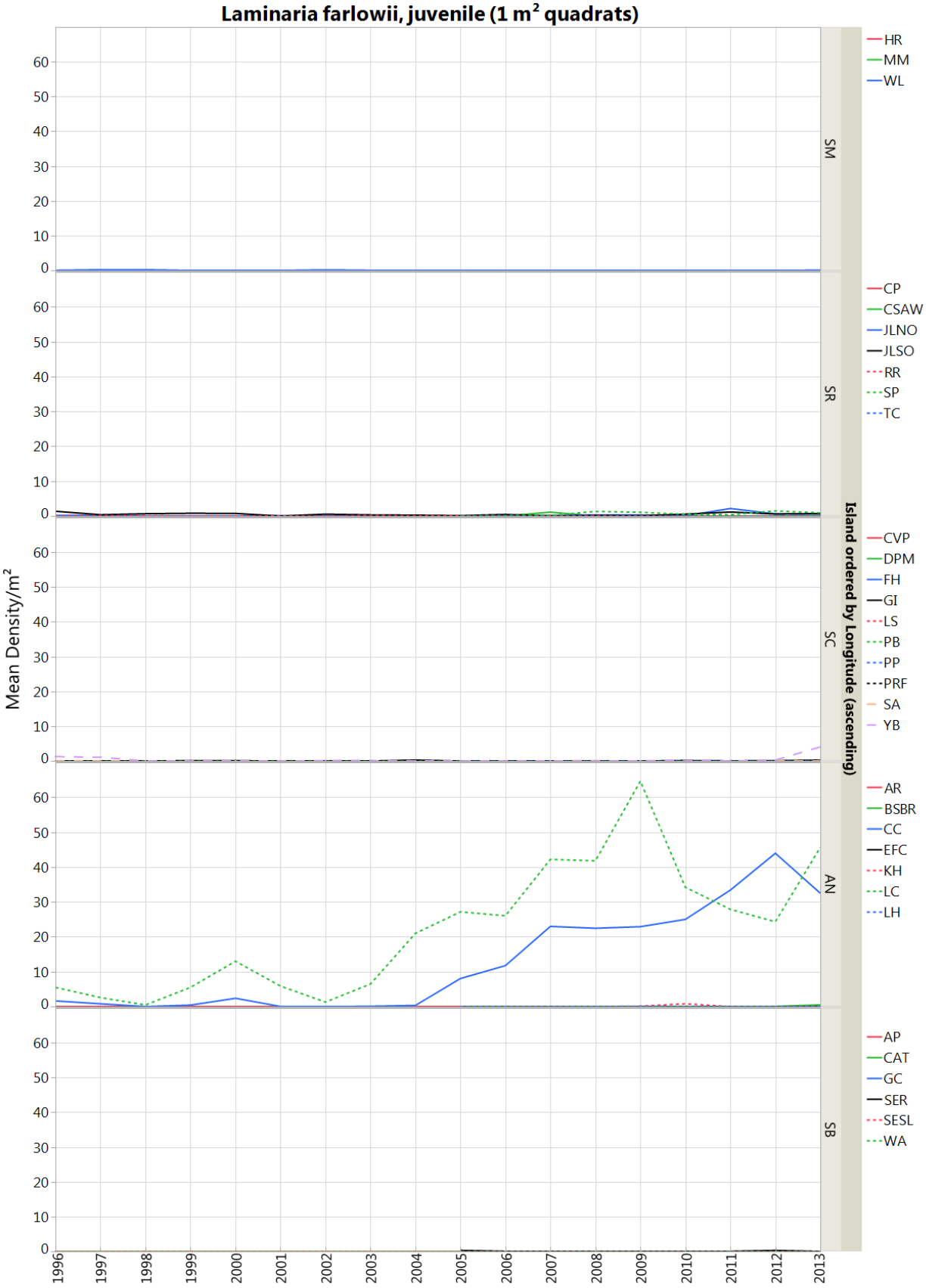

Eisenia arborea, adult (1 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
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YB
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BSBR
CC
EFC
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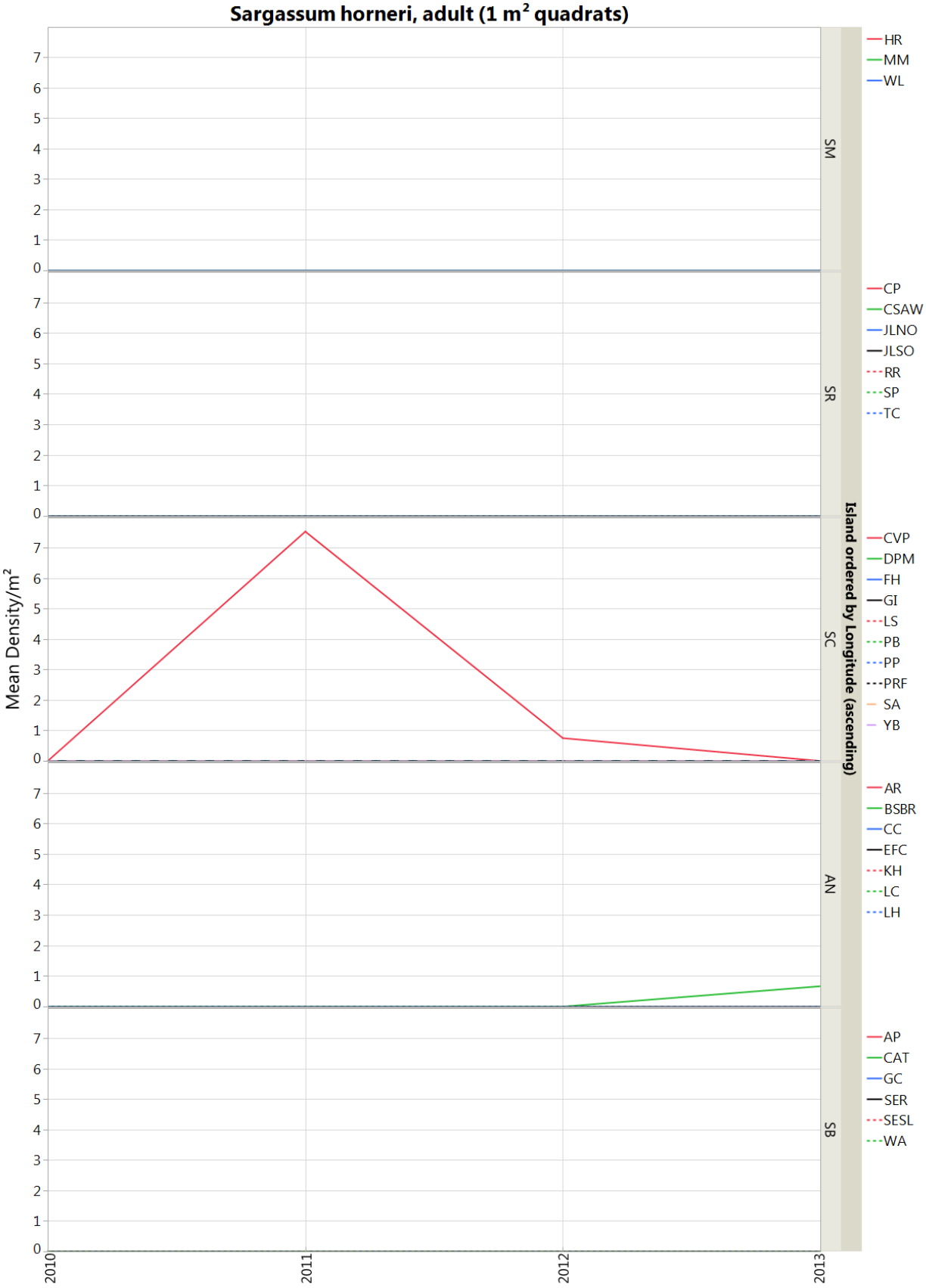

Eisenia arborea, juvenile (1 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
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WA
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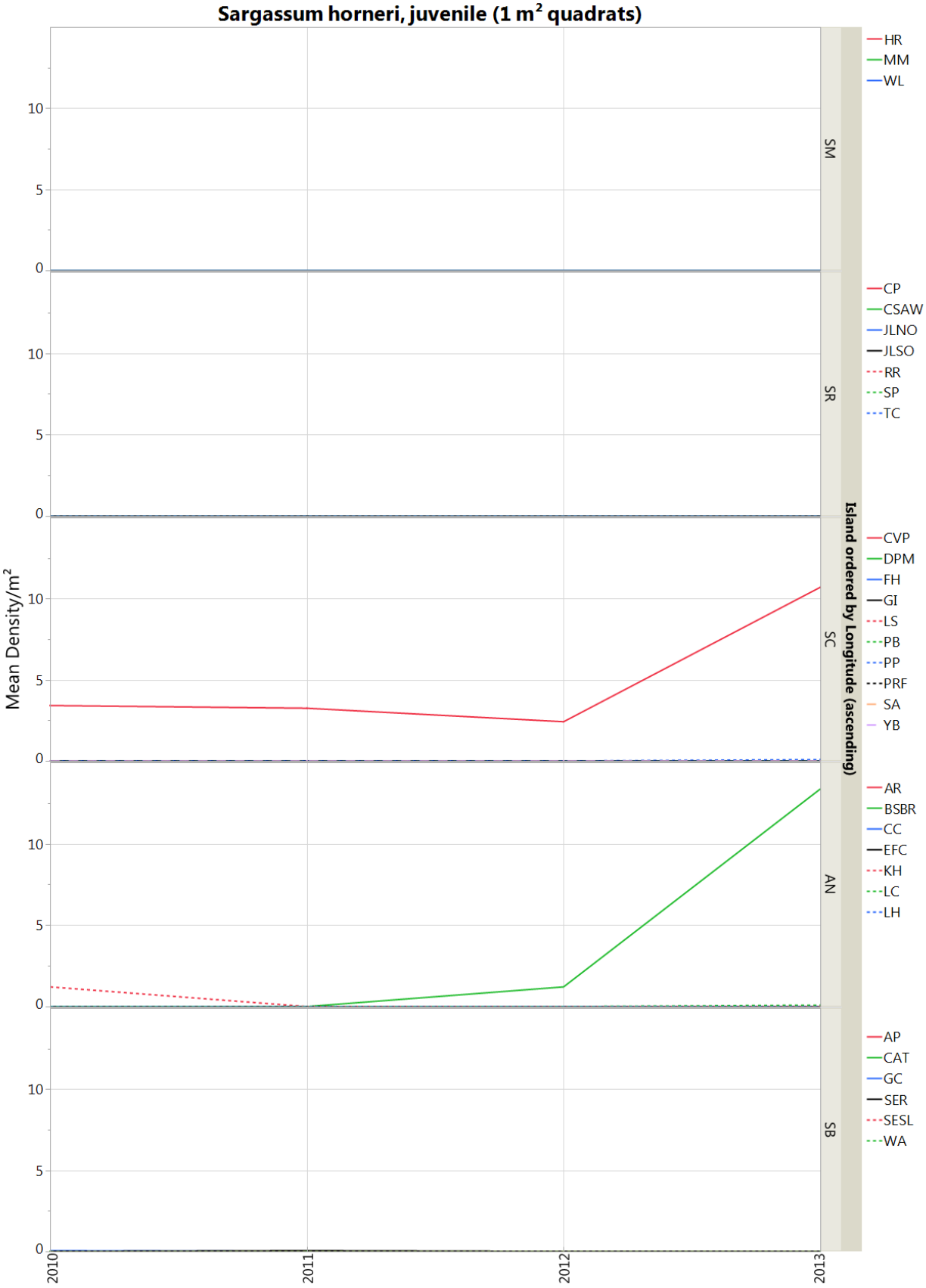

Pterygophora californica, adult (1 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
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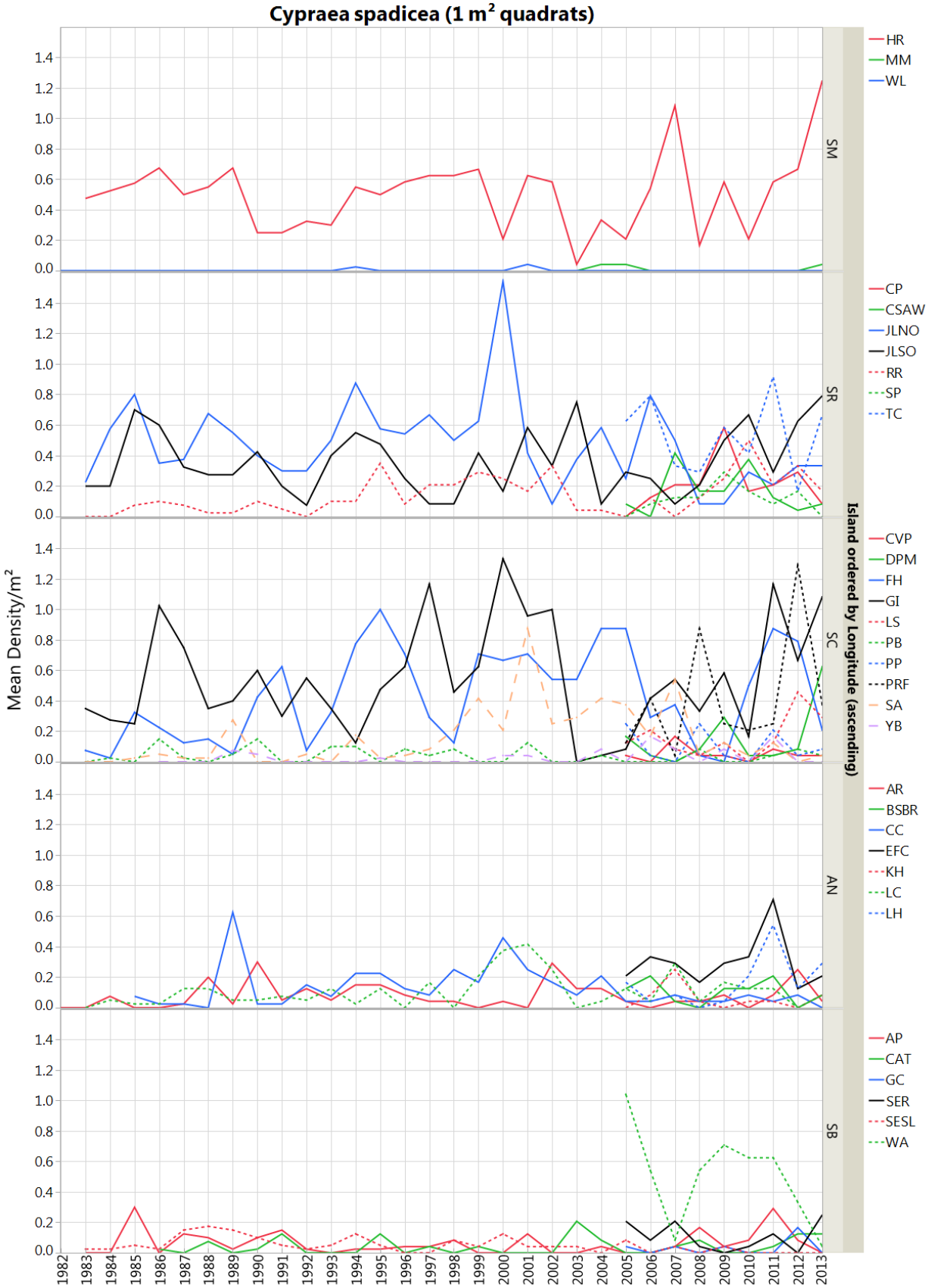

Pterygophora californica, juvenile (1 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
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SER
SESL
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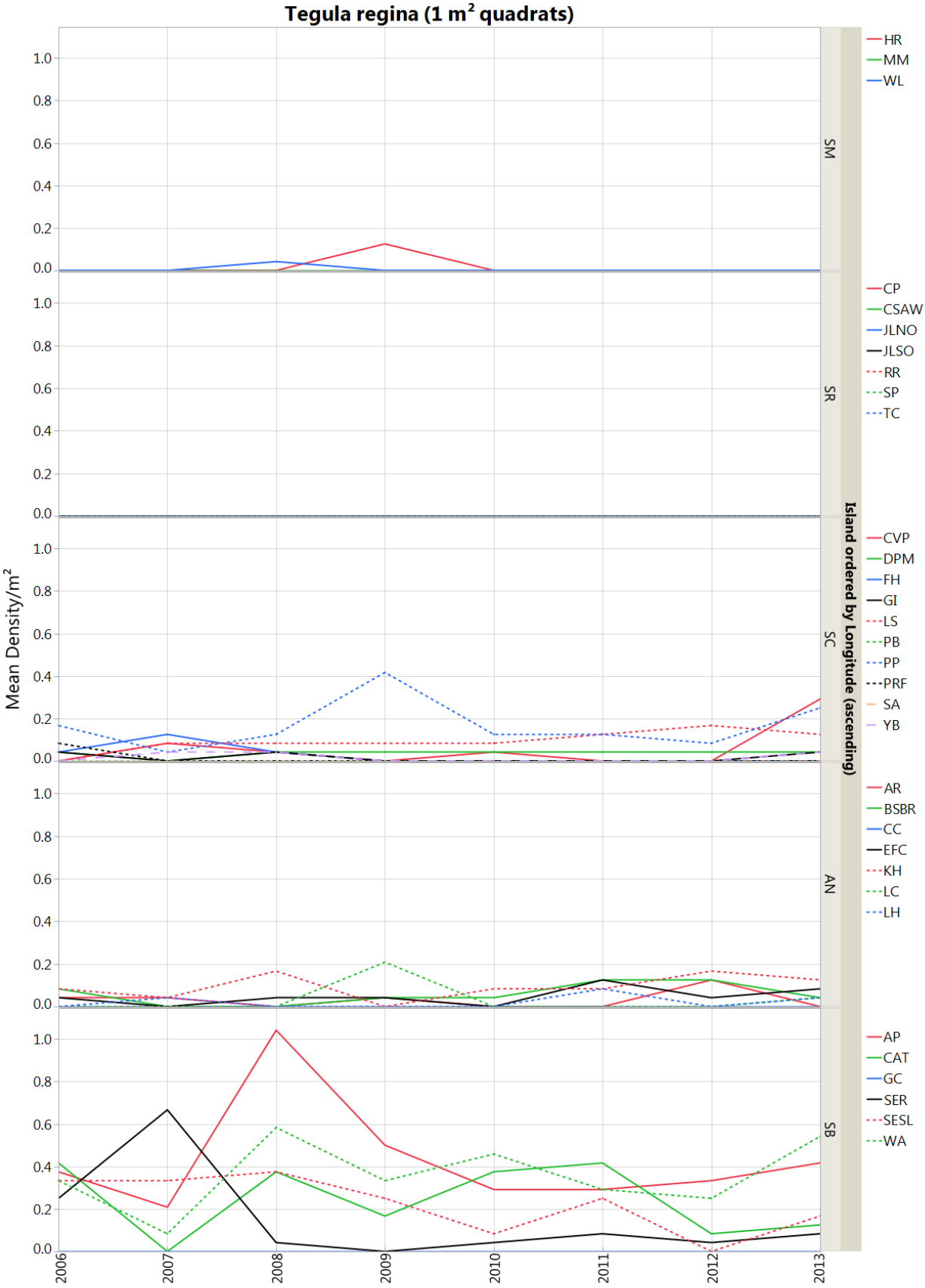

Laminaria farlowii, adult (1 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0.0
2.5
5.0
7.5
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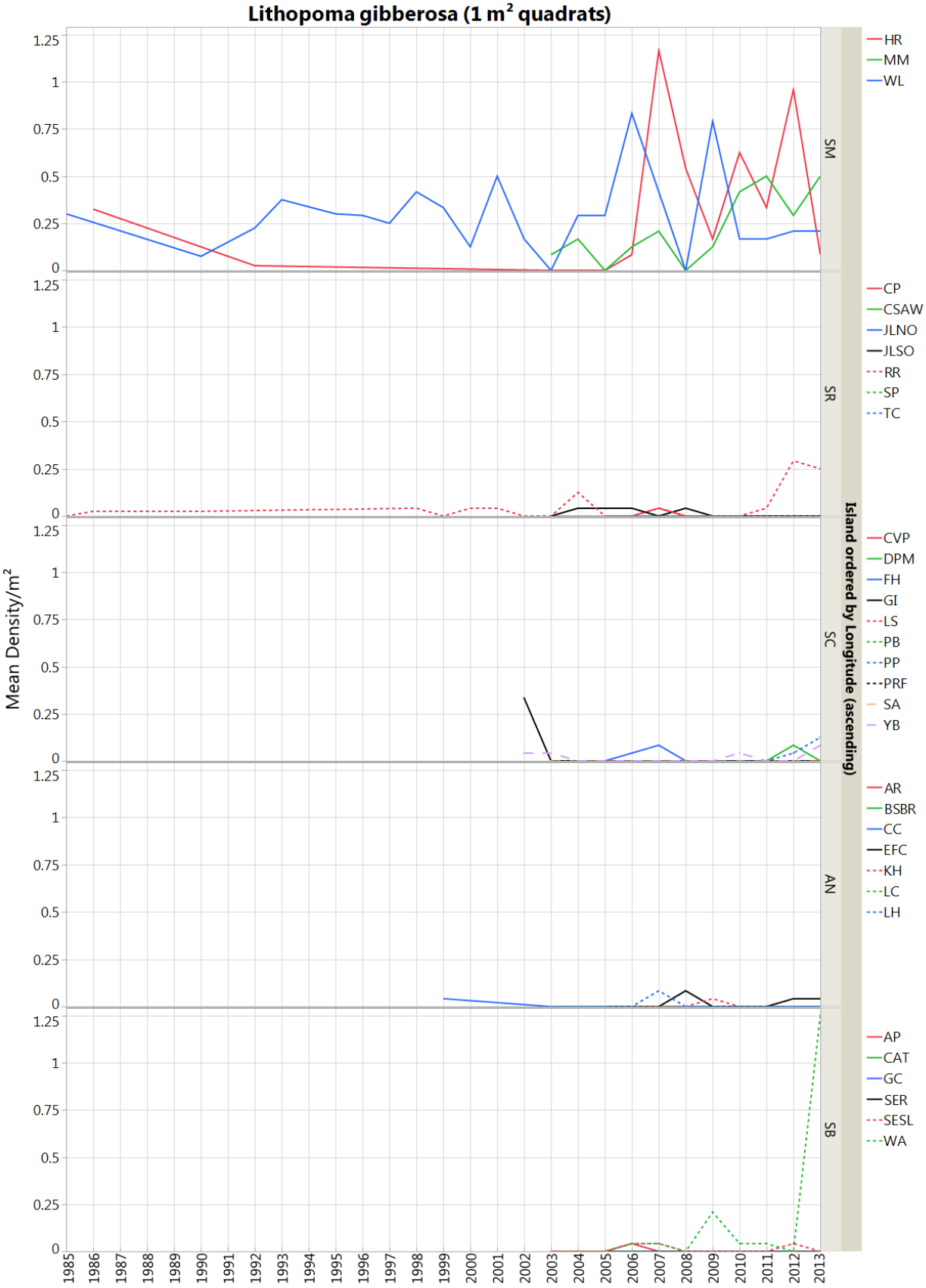

Laminaria farlowii, juvenile (1 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0
10
20
30
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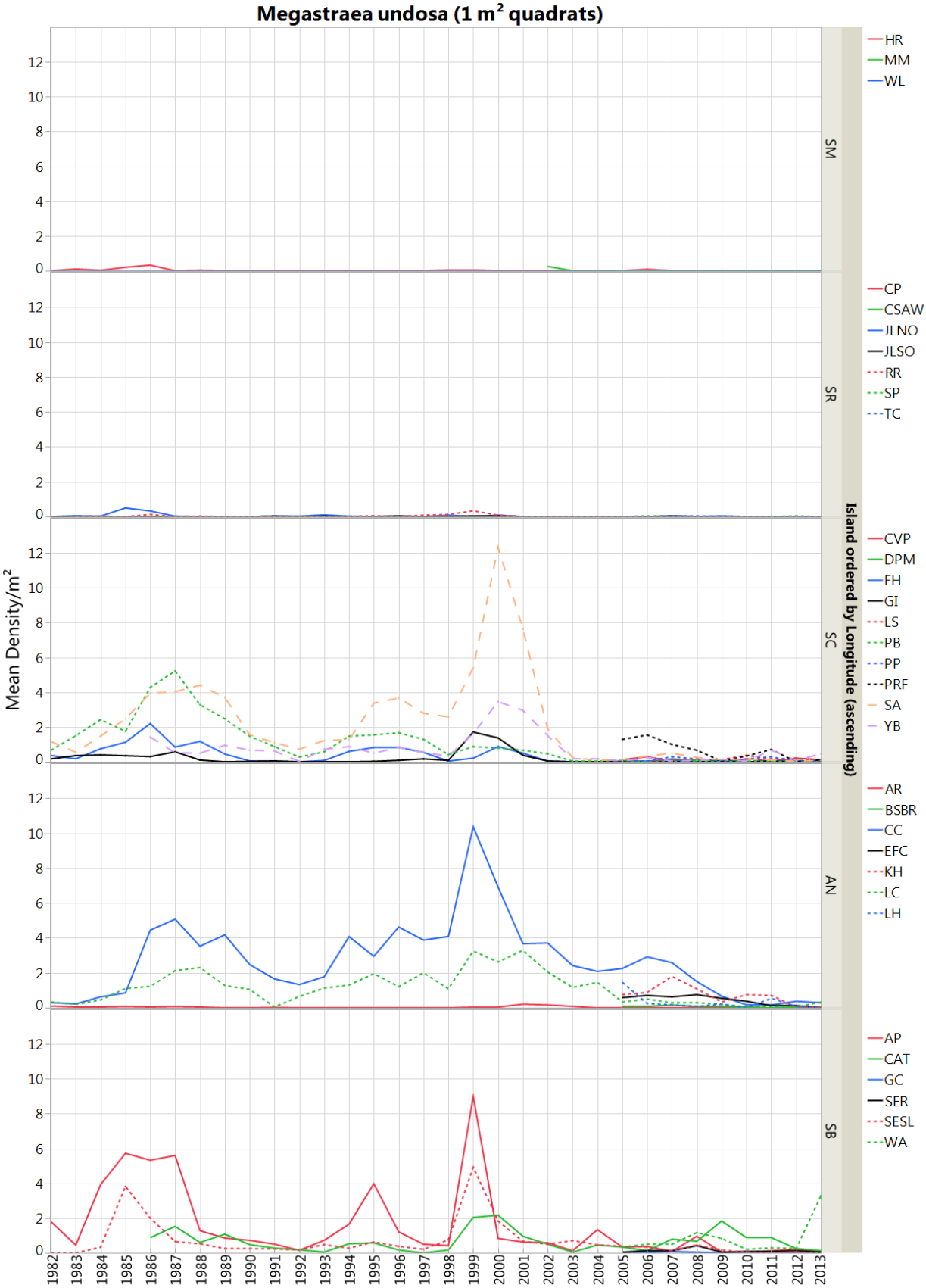

Sargassum horneri, adult (1 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
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7
2010
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2012
2013

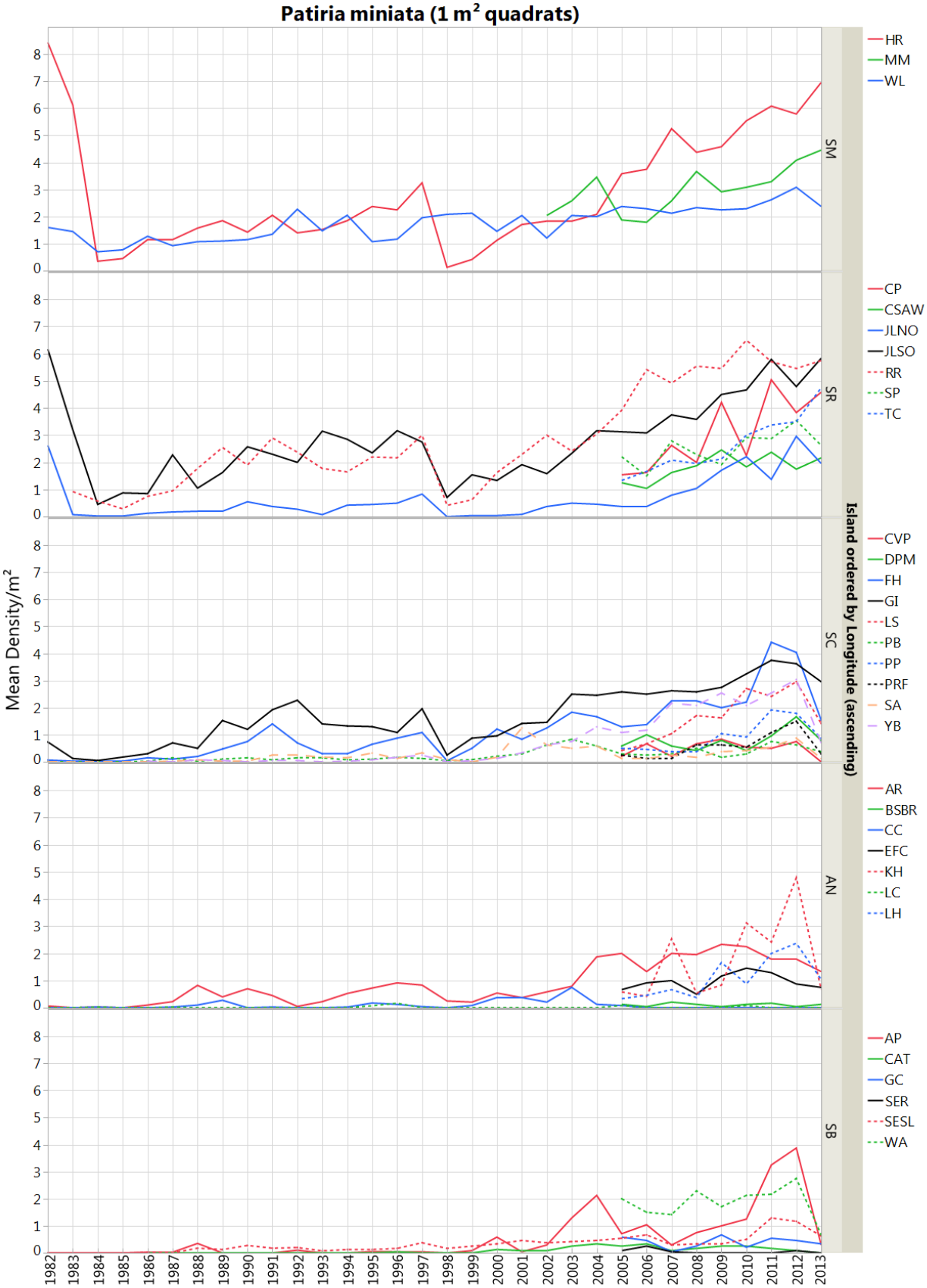

Sargassum horneri, juvenile (1 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0
5
10
2010
2011
2012
2013

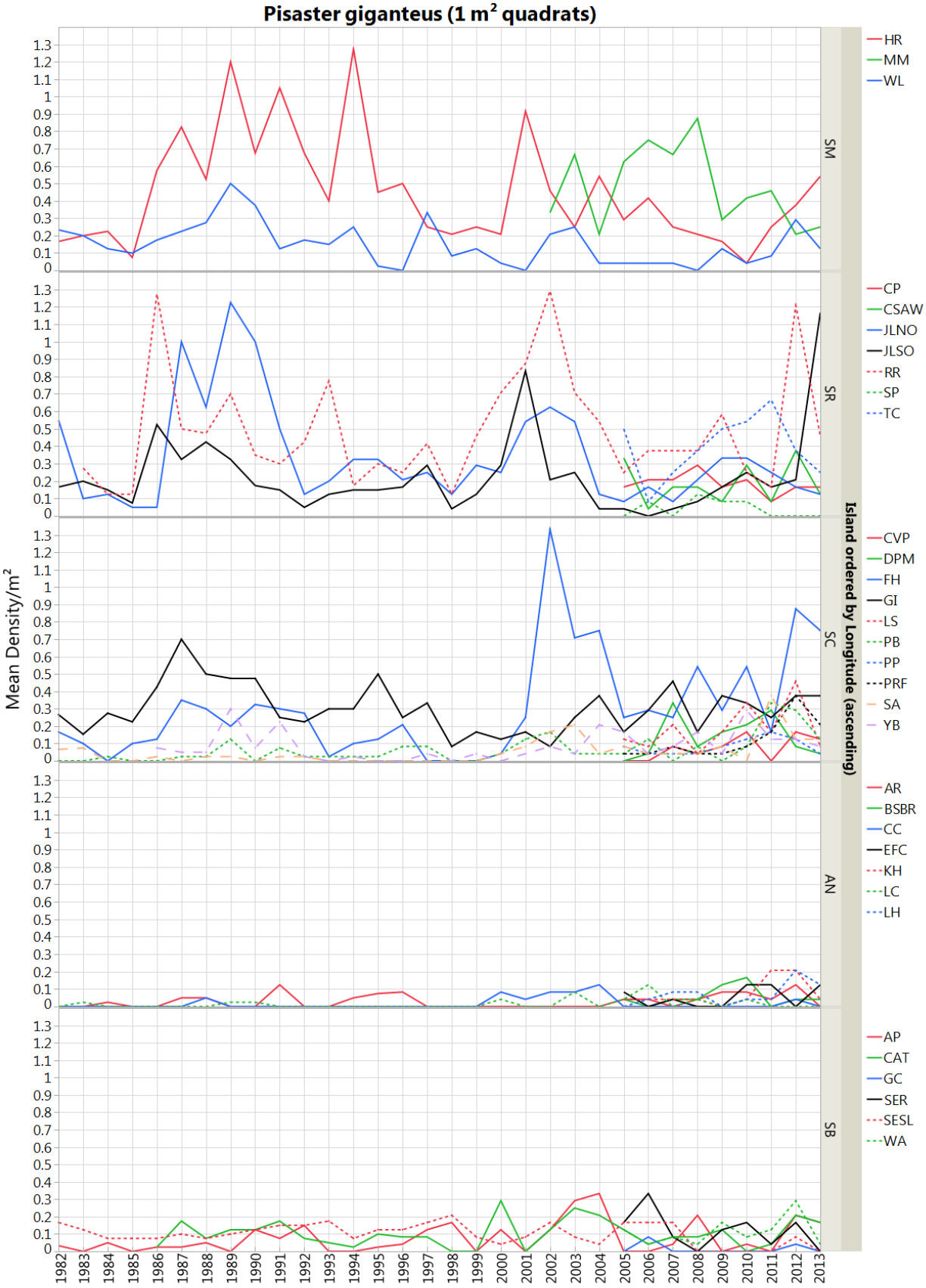

Cypraea spadicea (1 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
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2002
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2006
2007
2008
2009
2010
2011
2012
2013

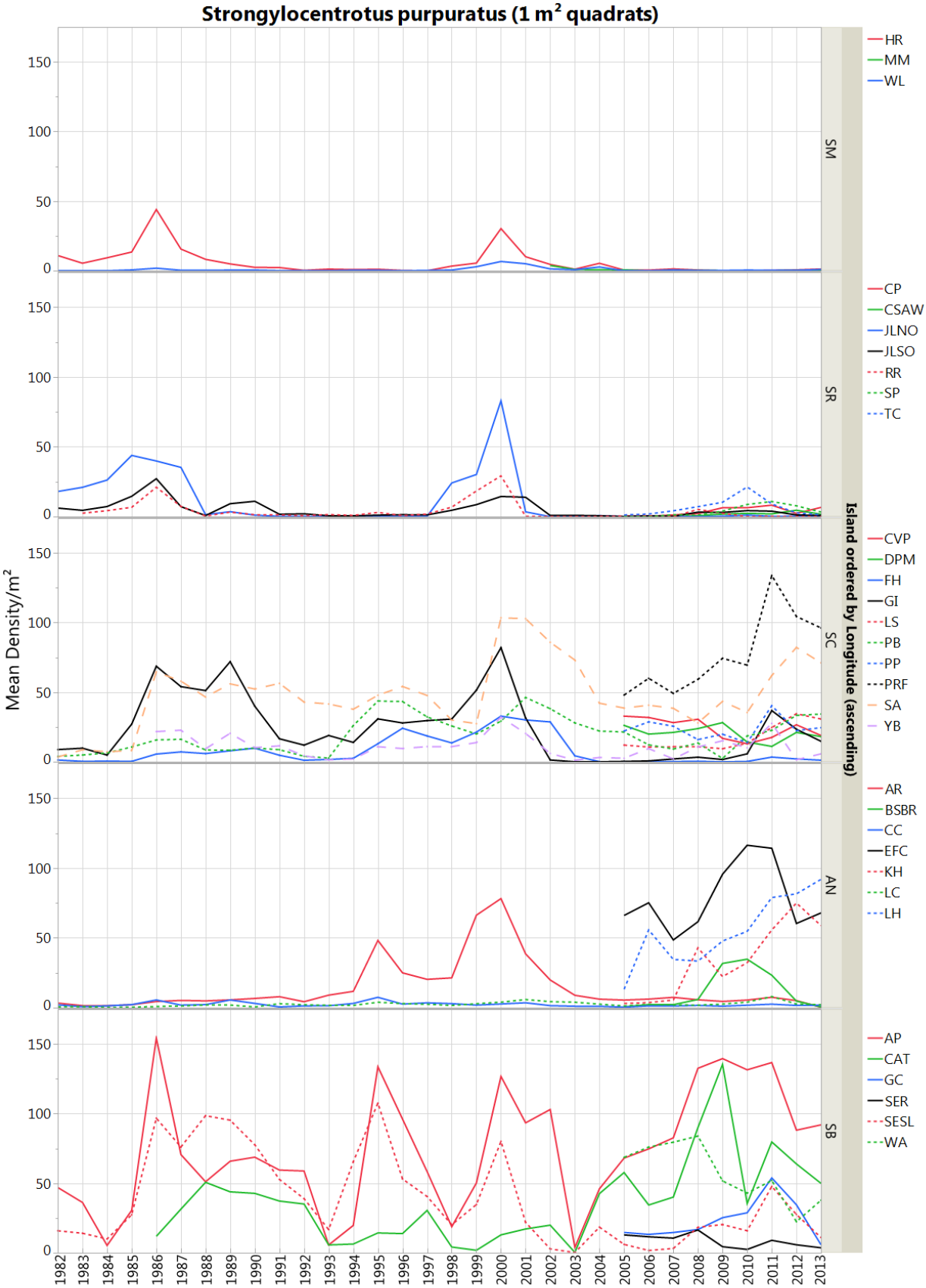

Tegula regina (1 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0.0
0.2
0.4
0.6
0.8
1.0
2006
2007
2008
2009
2010
2011
2012
2013

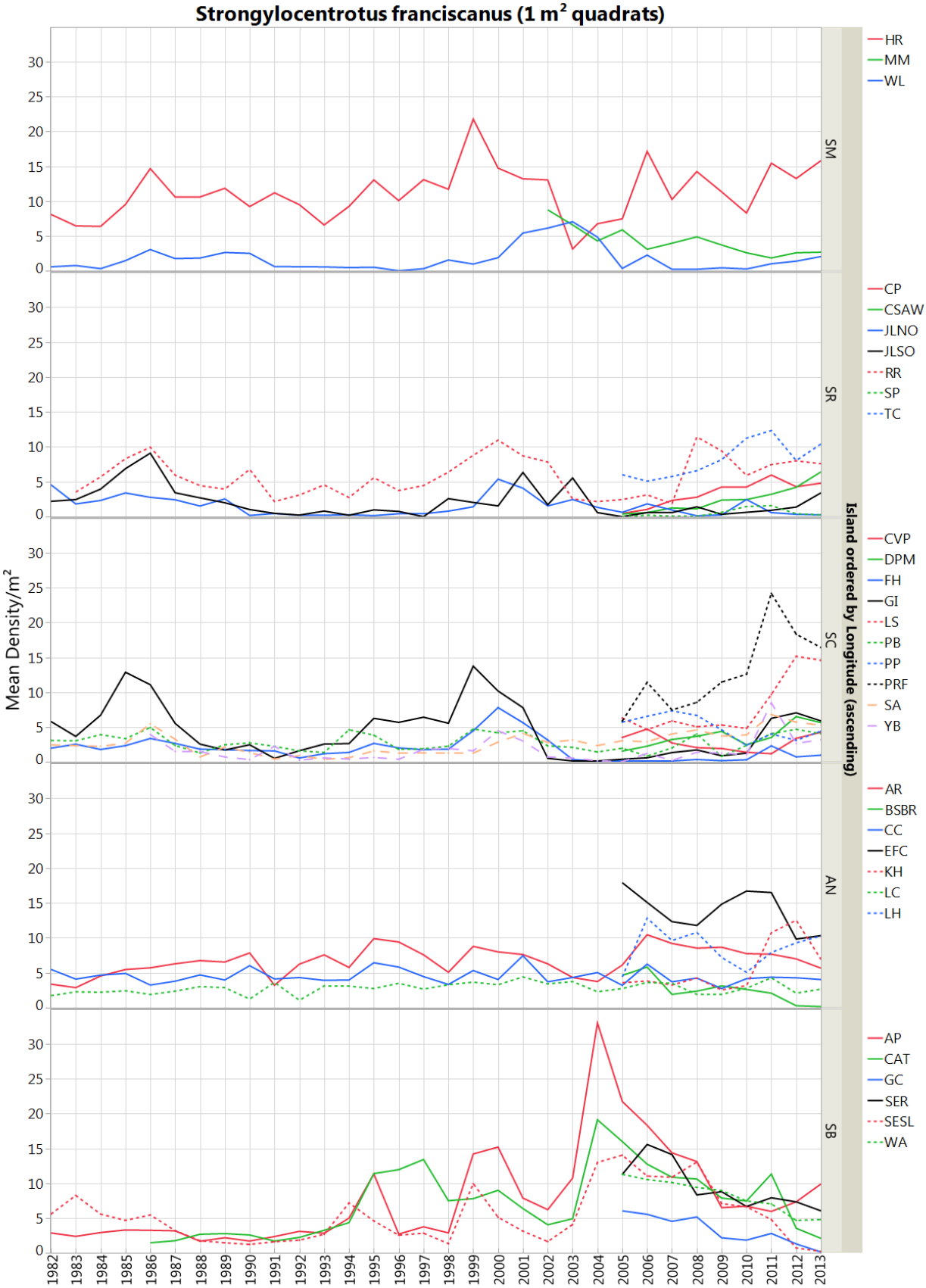

Lithopoma gibberosa (1 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0
0.25
0.5
0.75
1
1.25
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

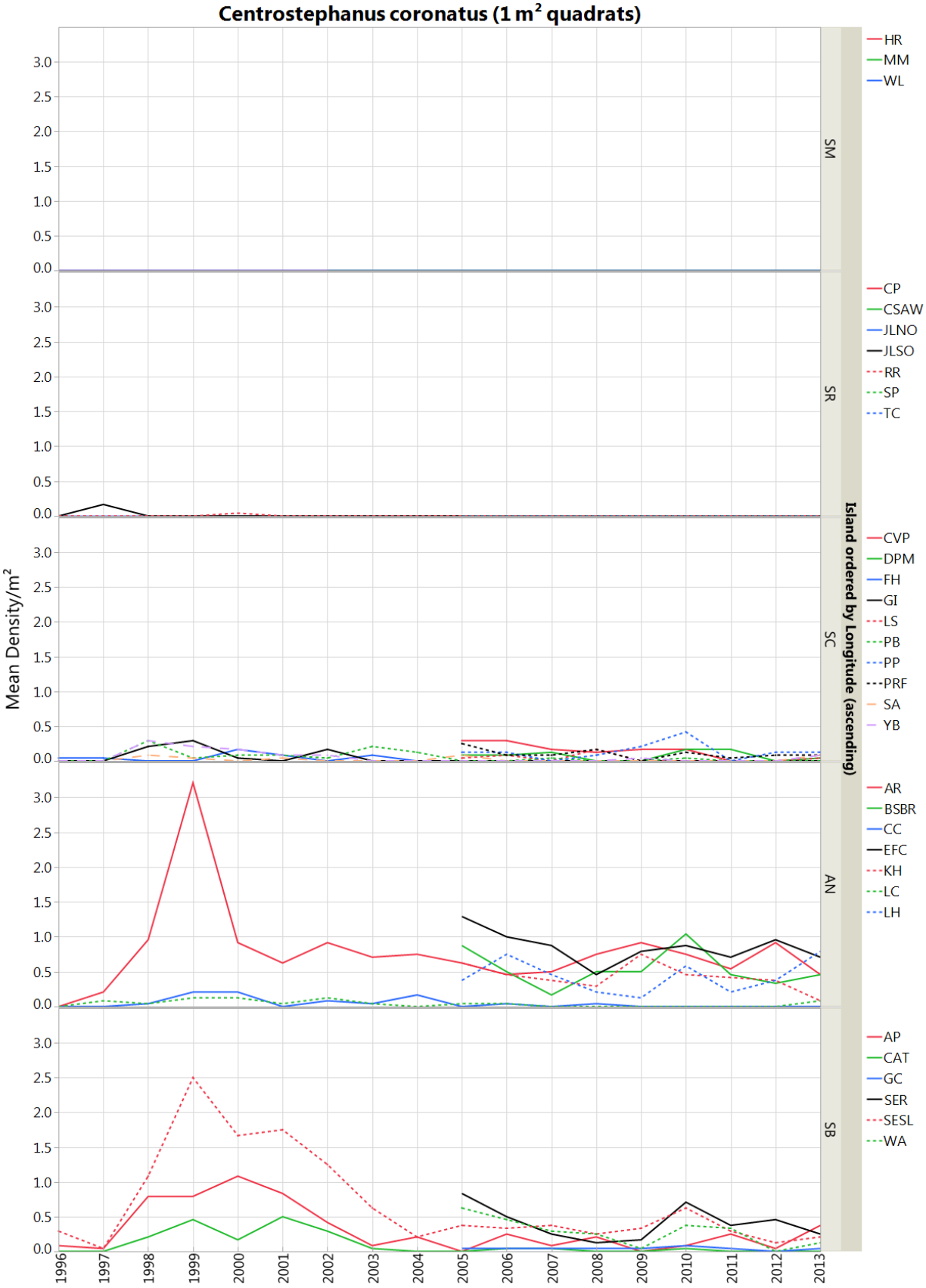

Megastraea undosa (1 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0
2
4
6
8
10
12
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
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2002
2003
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2007
2008
2009
2010
2011
2012
2013

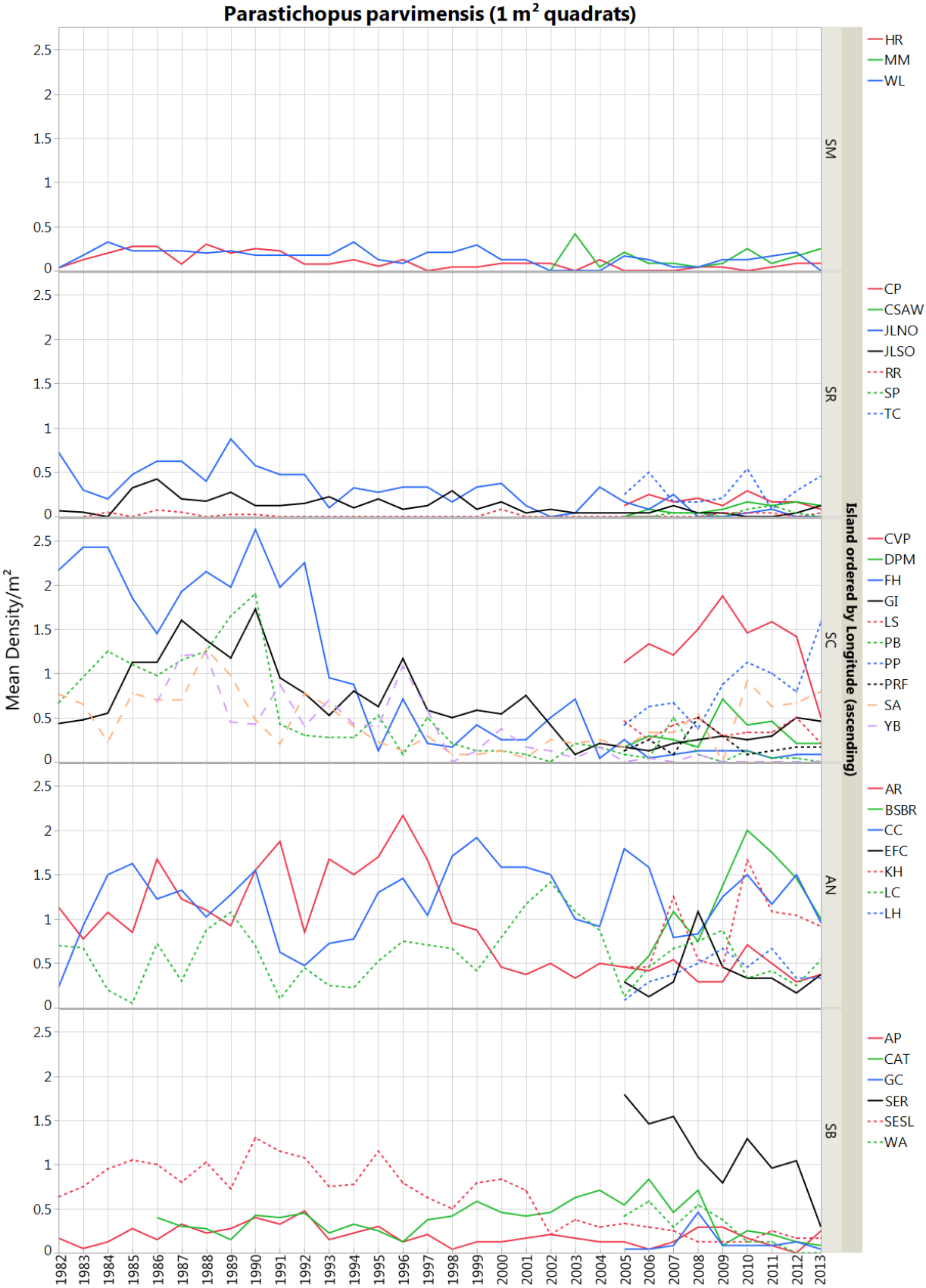

Patiria miniata (1 m² quadrats)
Mean Density/m²
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
Island ordered by Longitude (ascending)
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

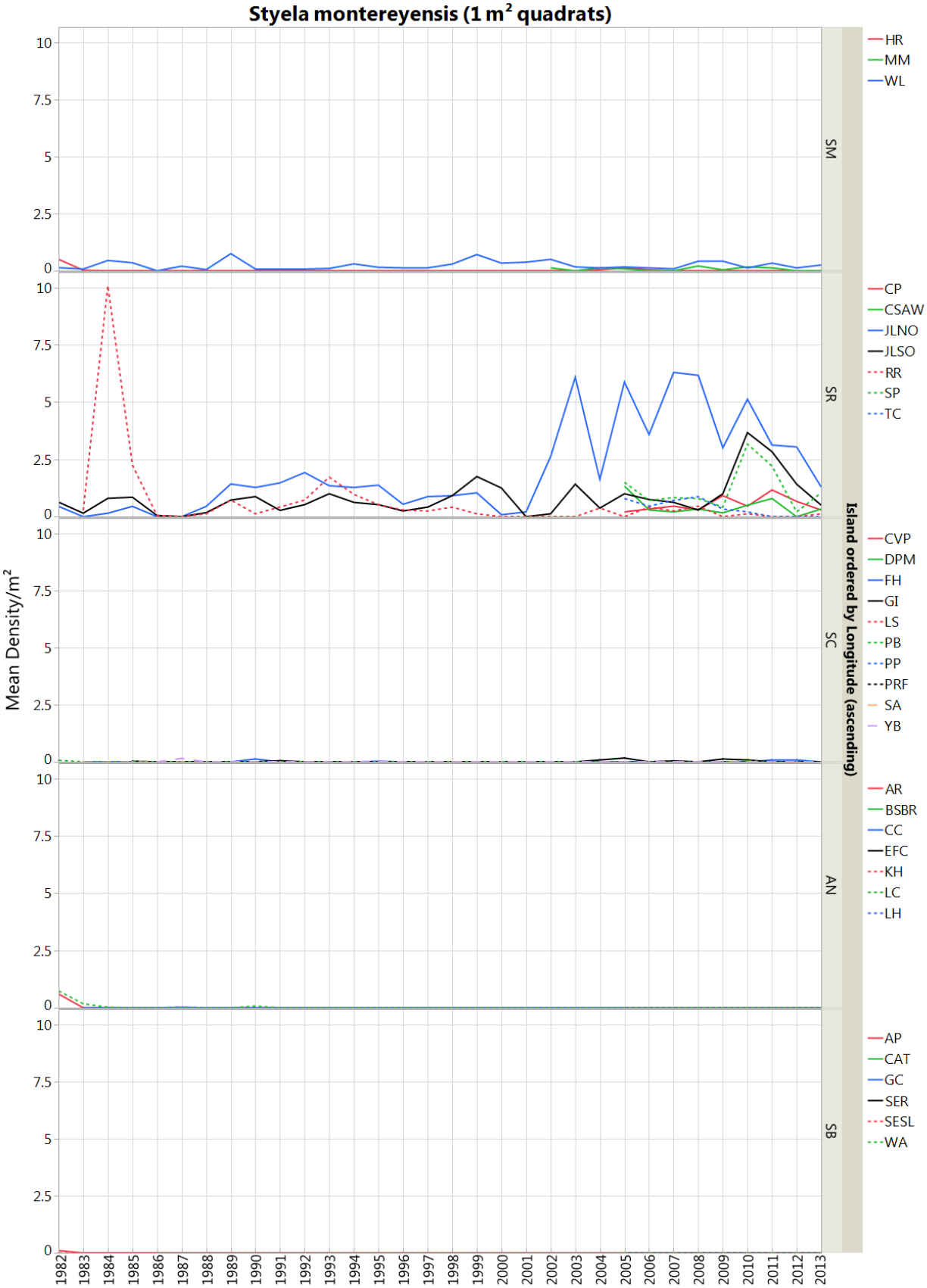

Pisaster giganteus (1 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
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1998
1999
2000
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2002
2003
2004
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2006
2007
2008
2009
2010
2011
2012
2013

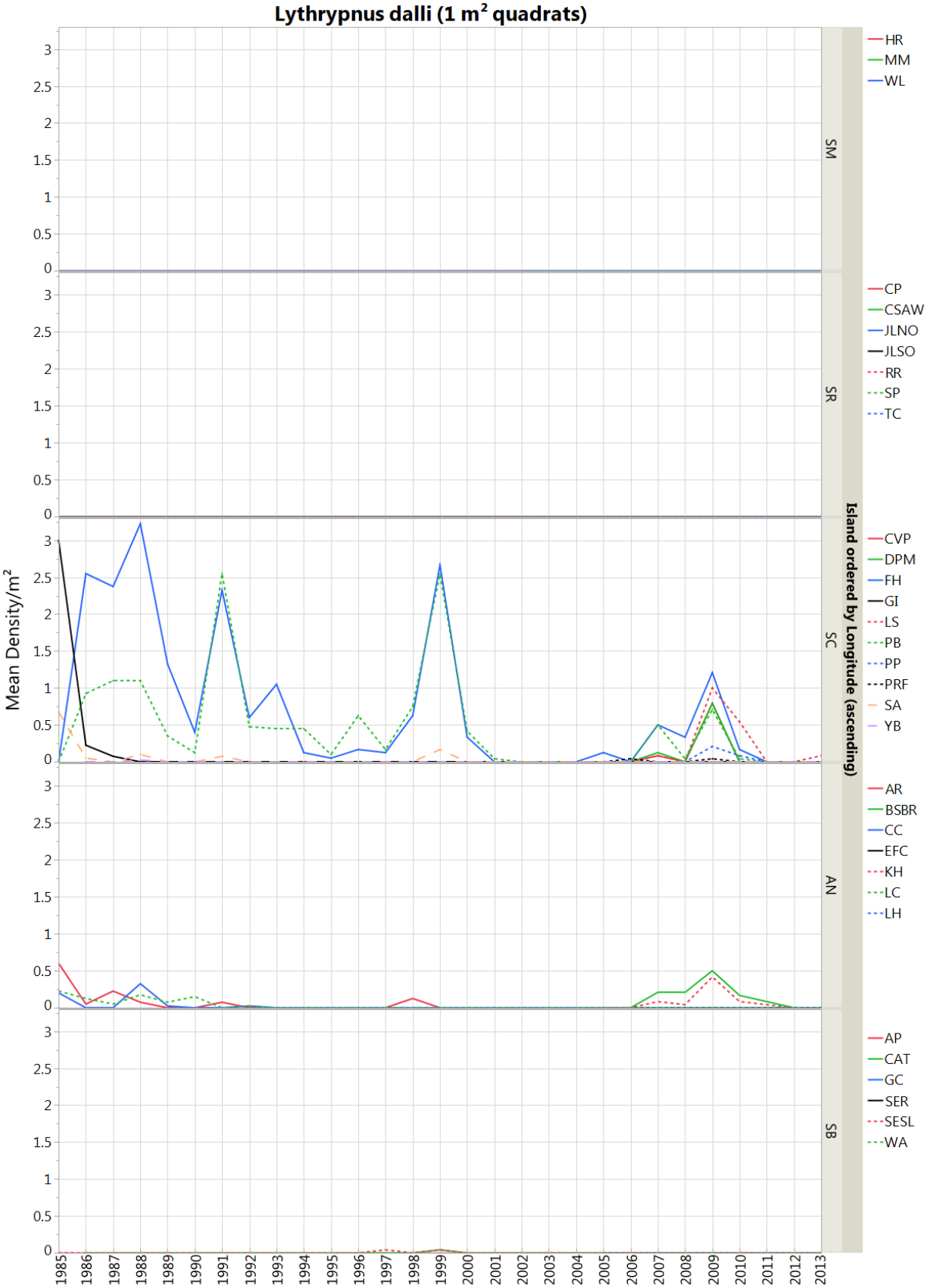

Strongylocentrotus purpuratus (1 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0
50
100
150
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

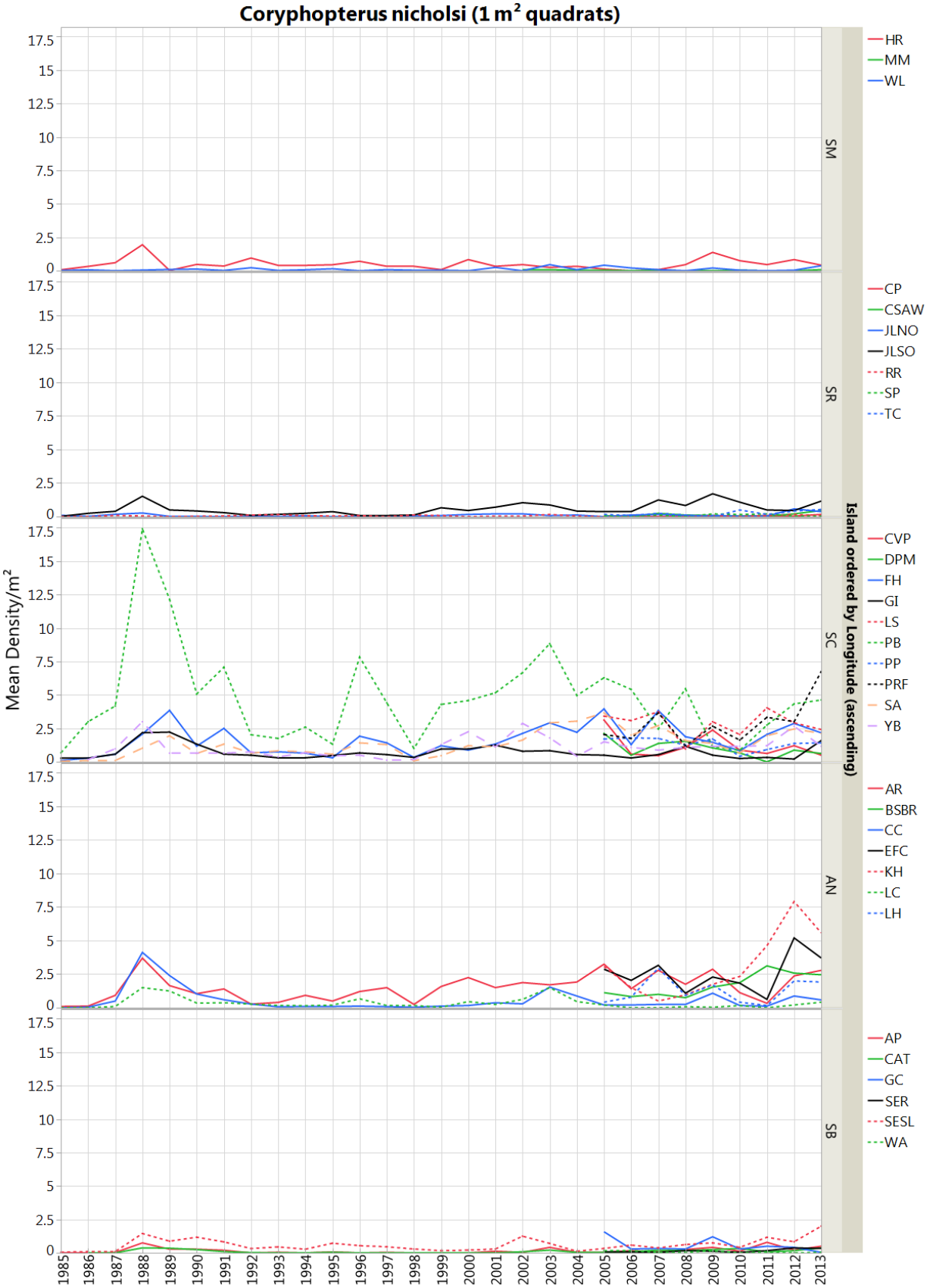

Strongylocentrotus franciscanus (1 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0
5
10
15
20
25
30
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
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2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

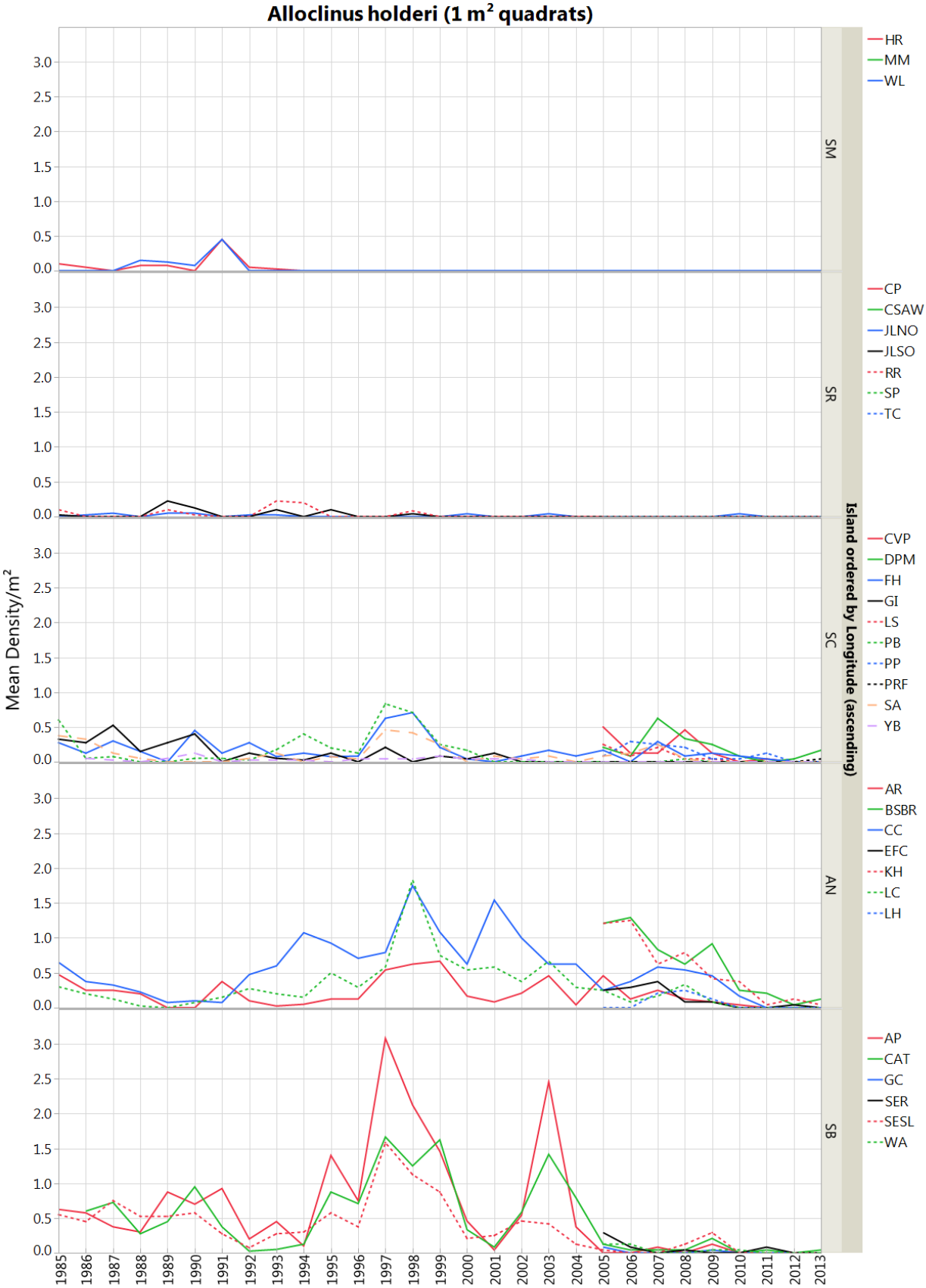

Centrostephanus coronatus (1 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013


Parastichopus parvimensis (1 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0
0.5
1
1.5
2
2.5
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

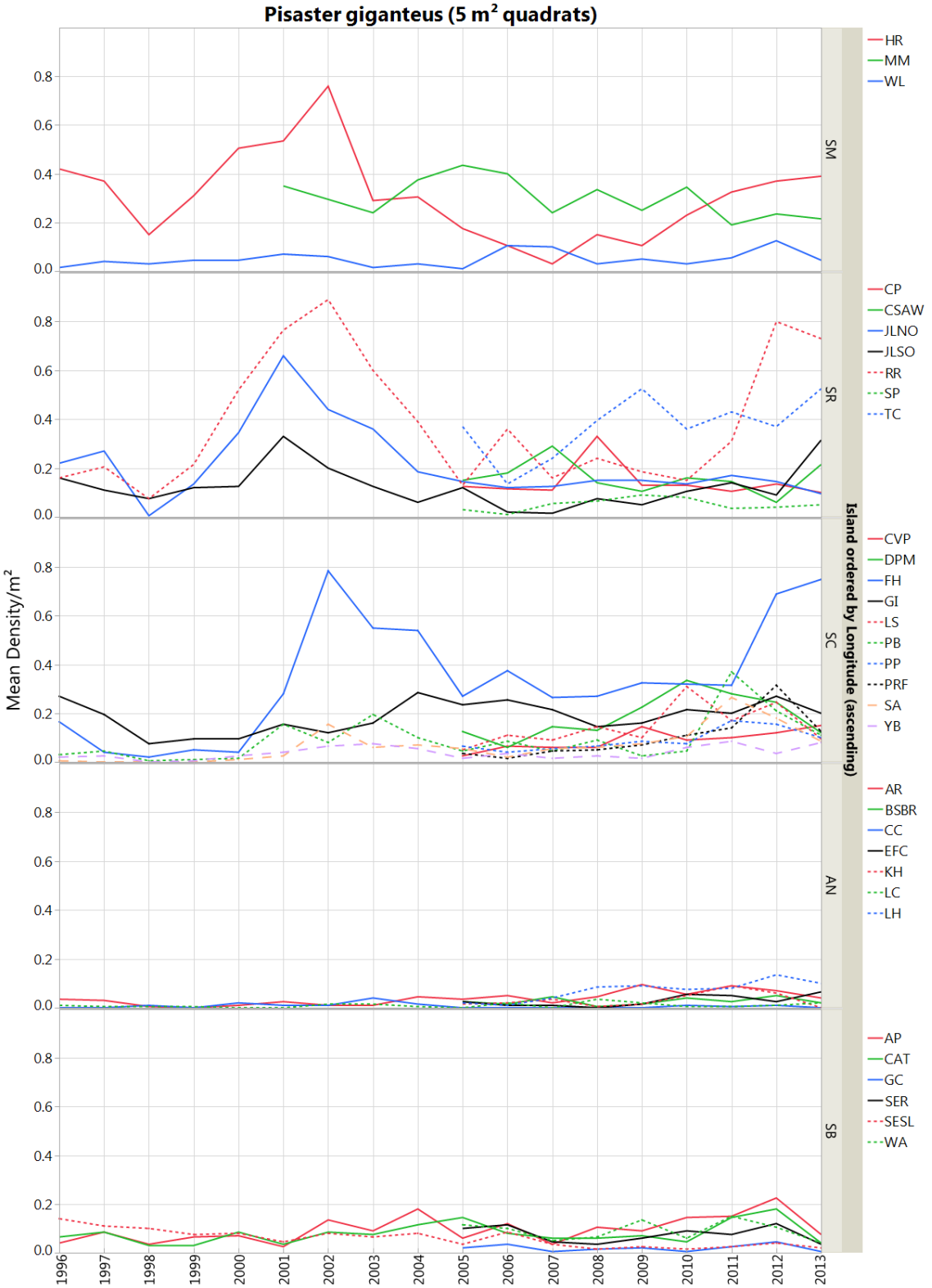

Styela montereyensis (1 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0
2.5
5
7.5
10
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

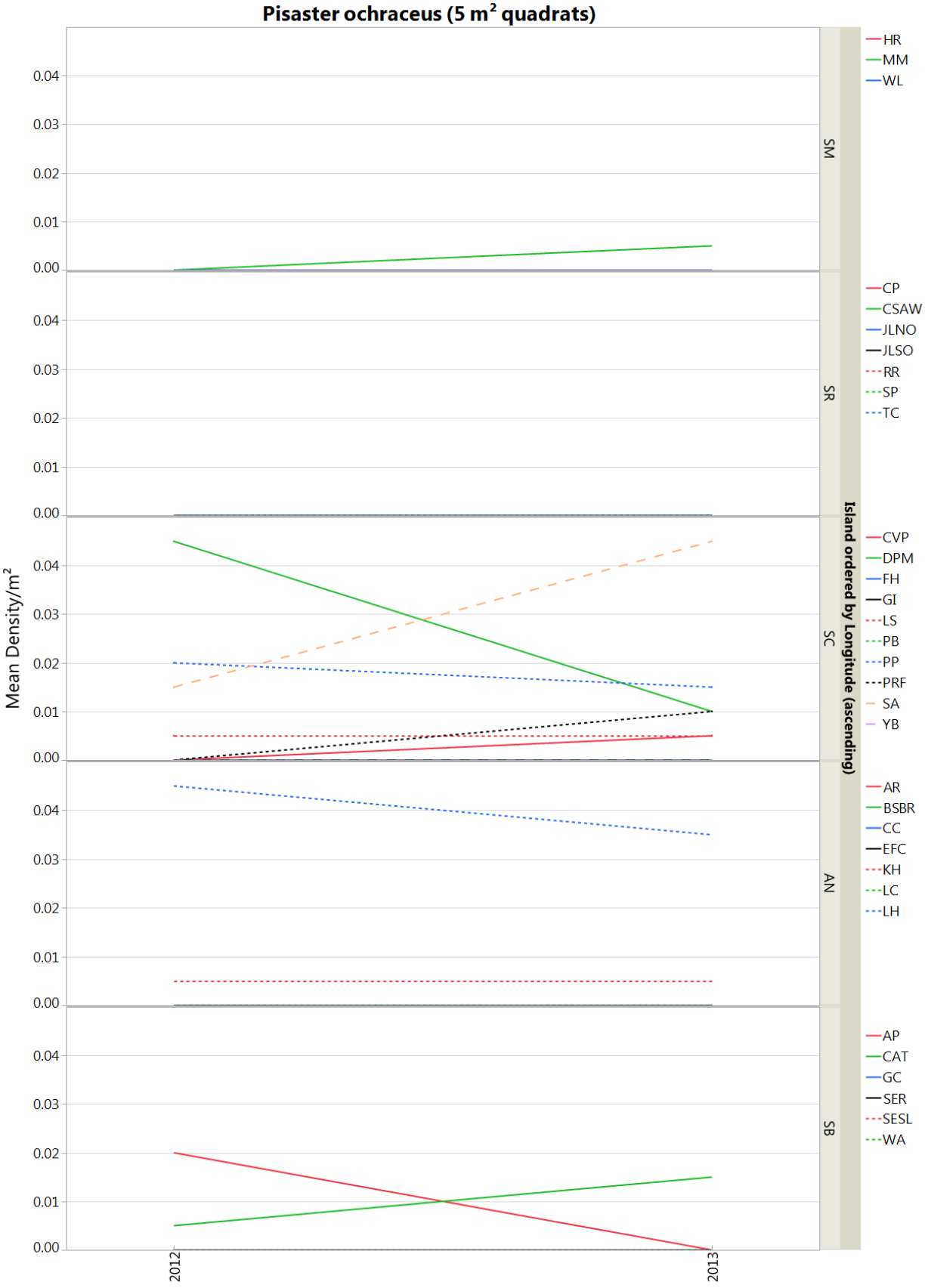

Lythrypnus dalli (1 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0
0.5
1
1.5
2
2.5
3
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

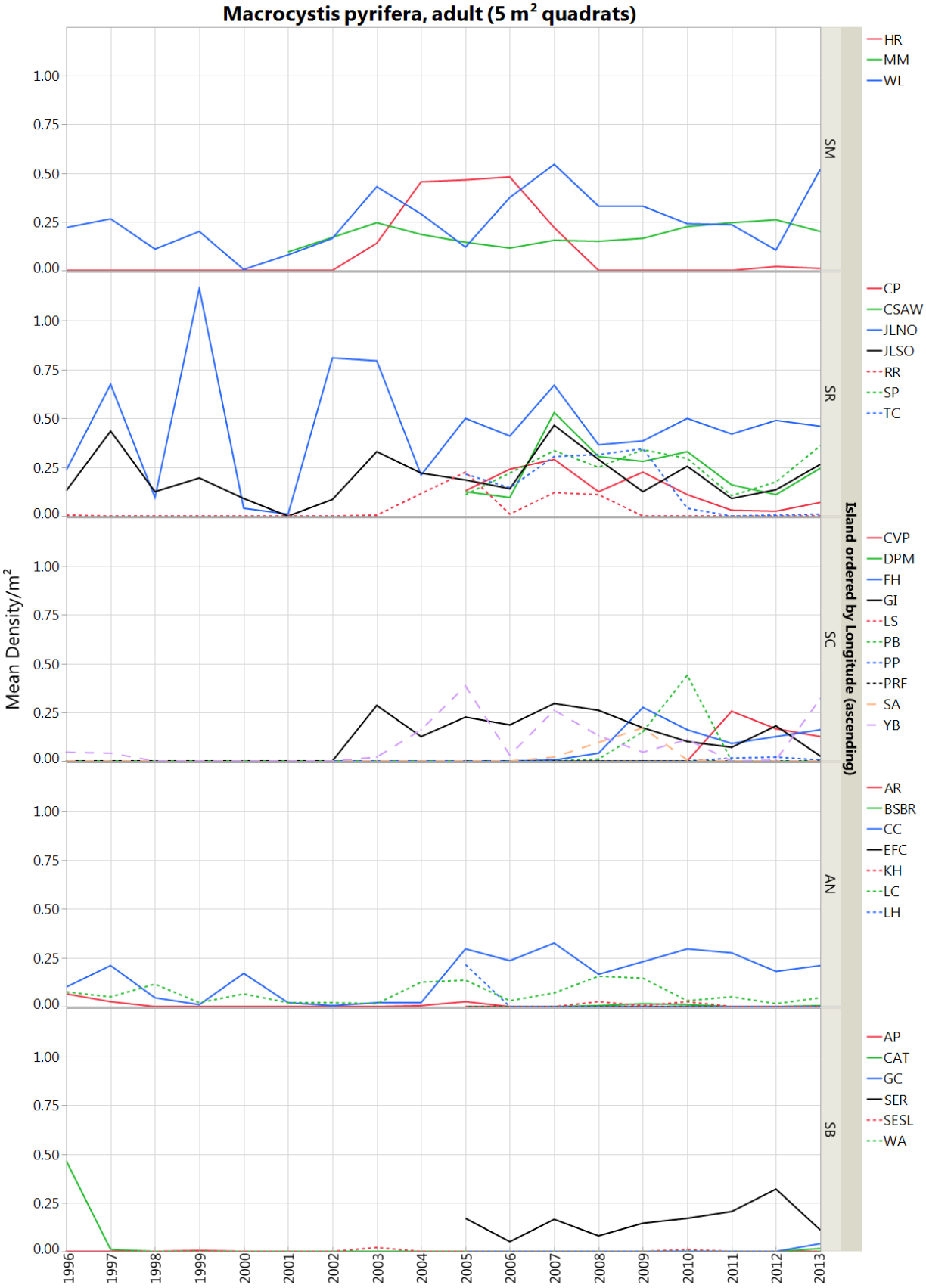

Coryphopterus nicholsi (1 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0
2.5
5
7.5
10
12.5
15
17.5
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

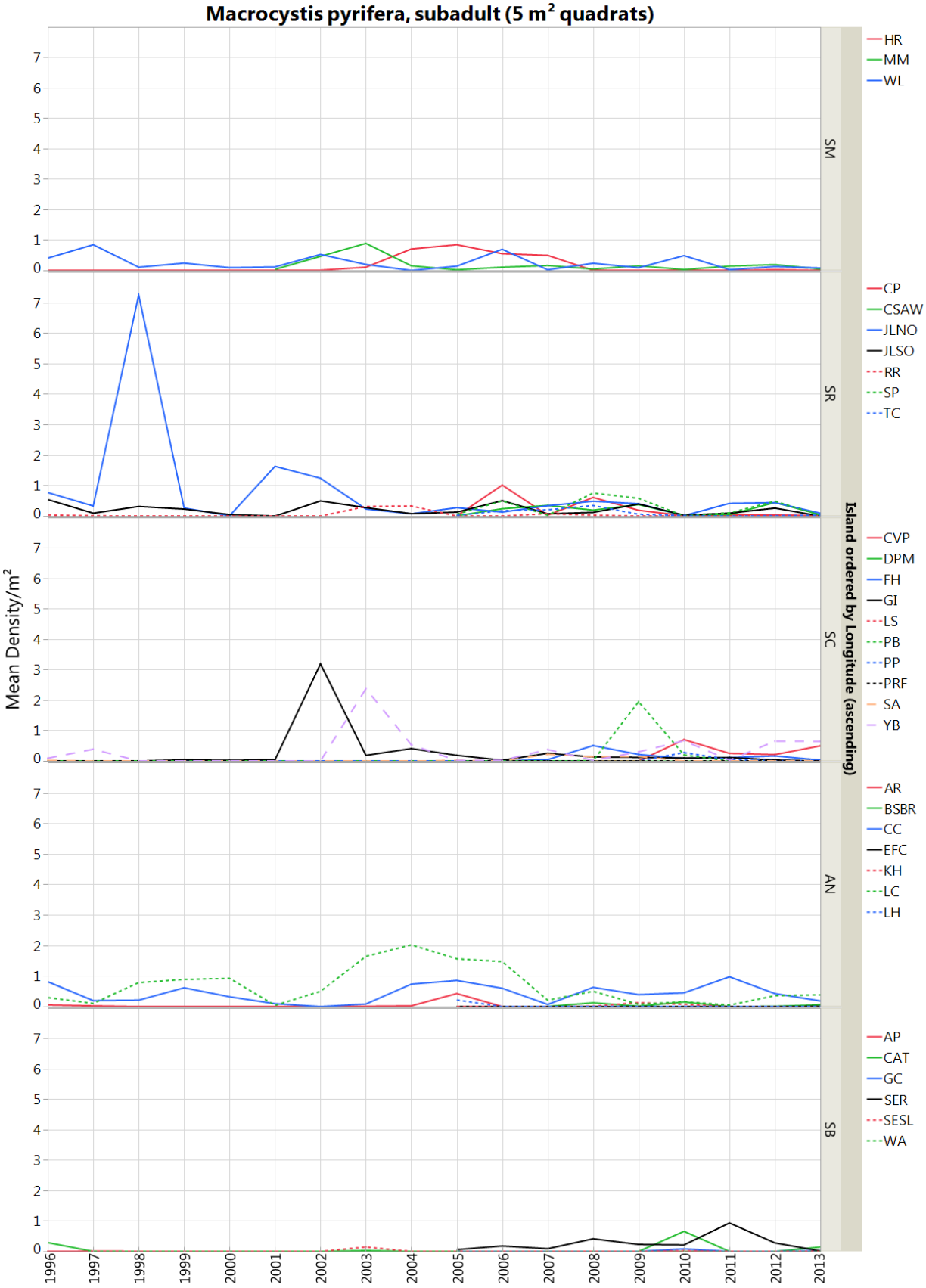

Alloclinus holderi (1 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

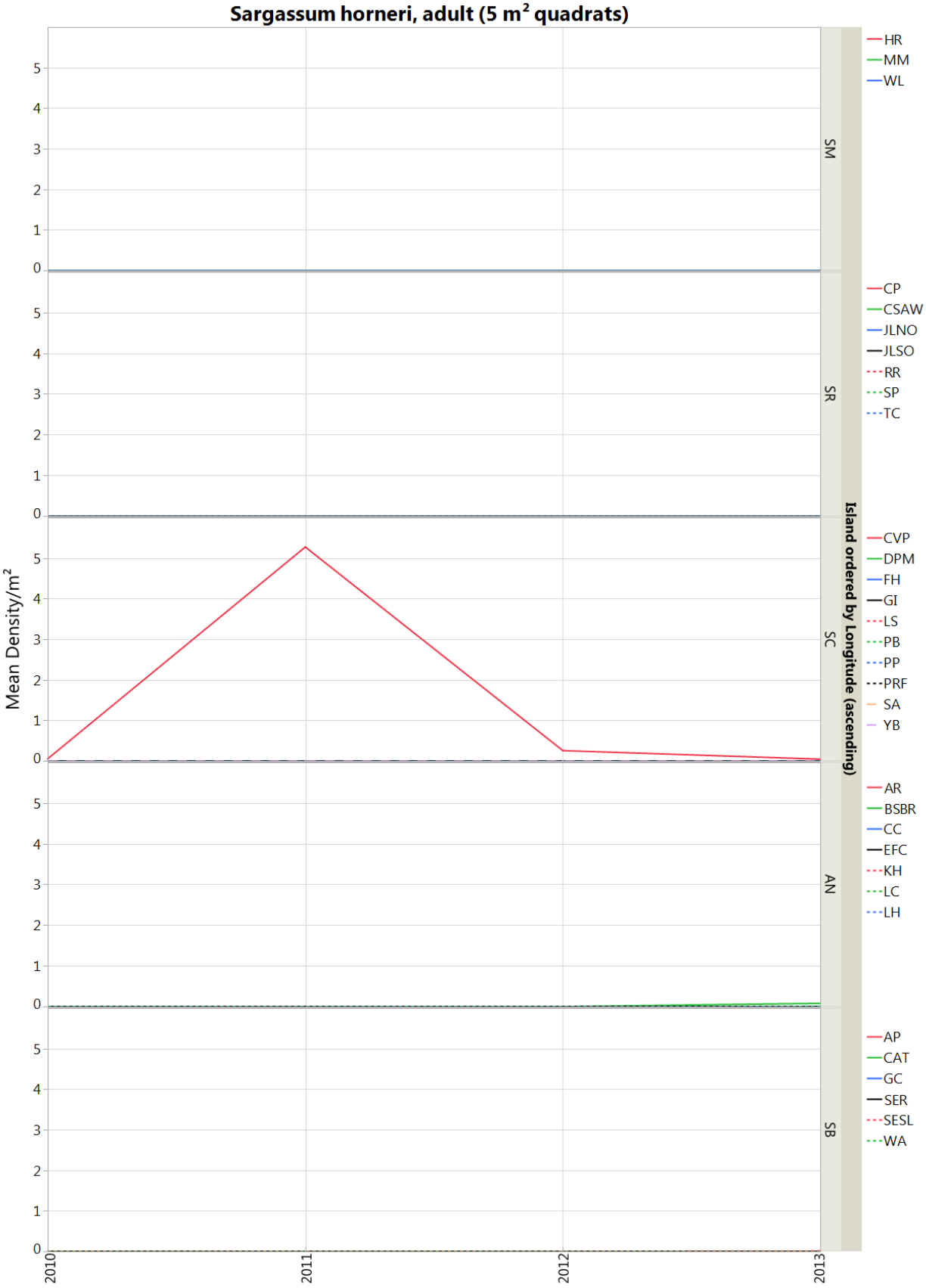
Appendix F. 5 Meter Quadrat Data

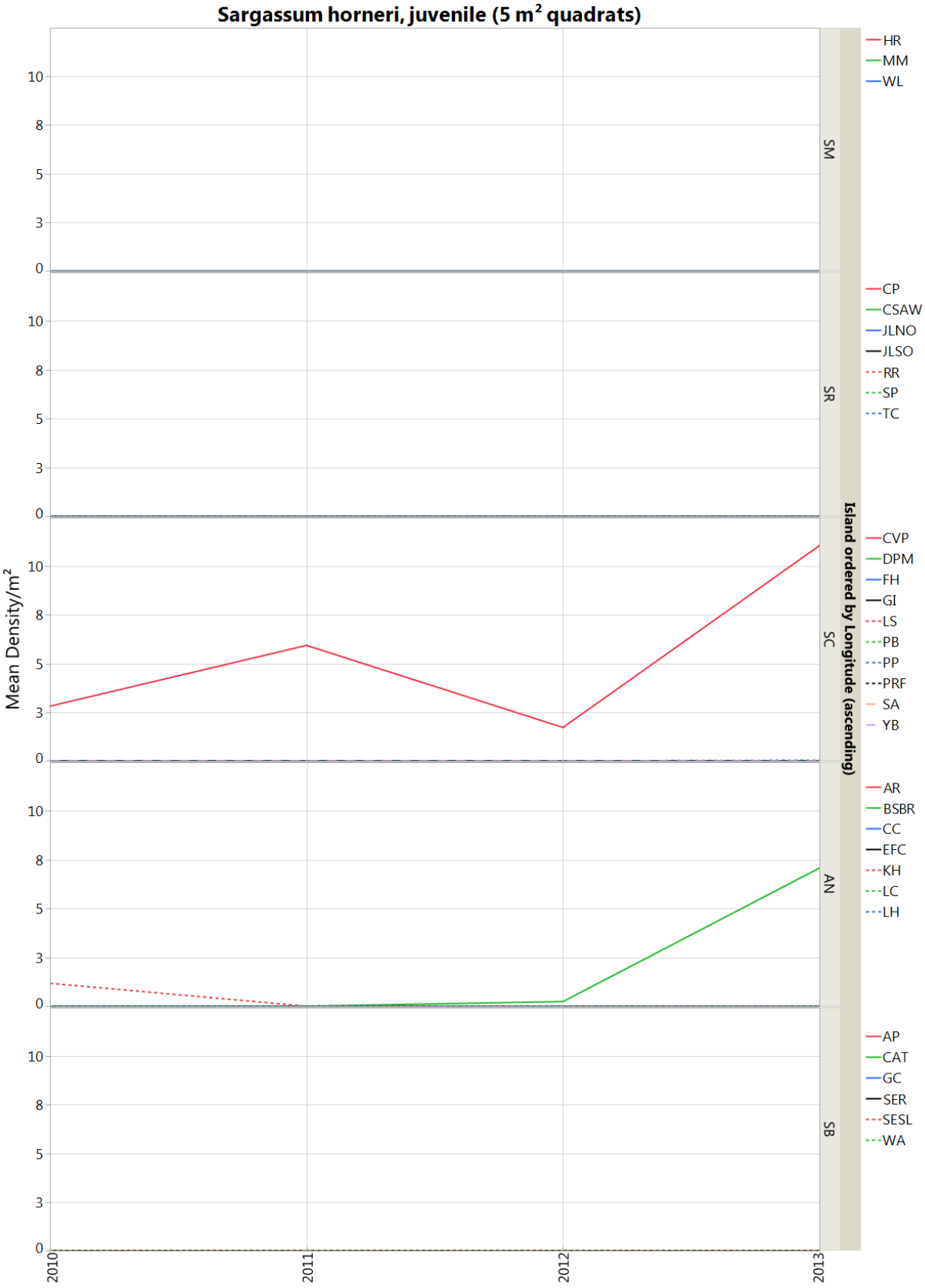



Pisaster ochraceus (5 m² quadrats)
Mean Density/m²
0.04
0.03
0.02
0.01
0.00
2012
2013
SM
SR
SC
AN
SB
Island ordered by Longitude (ascending)
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA

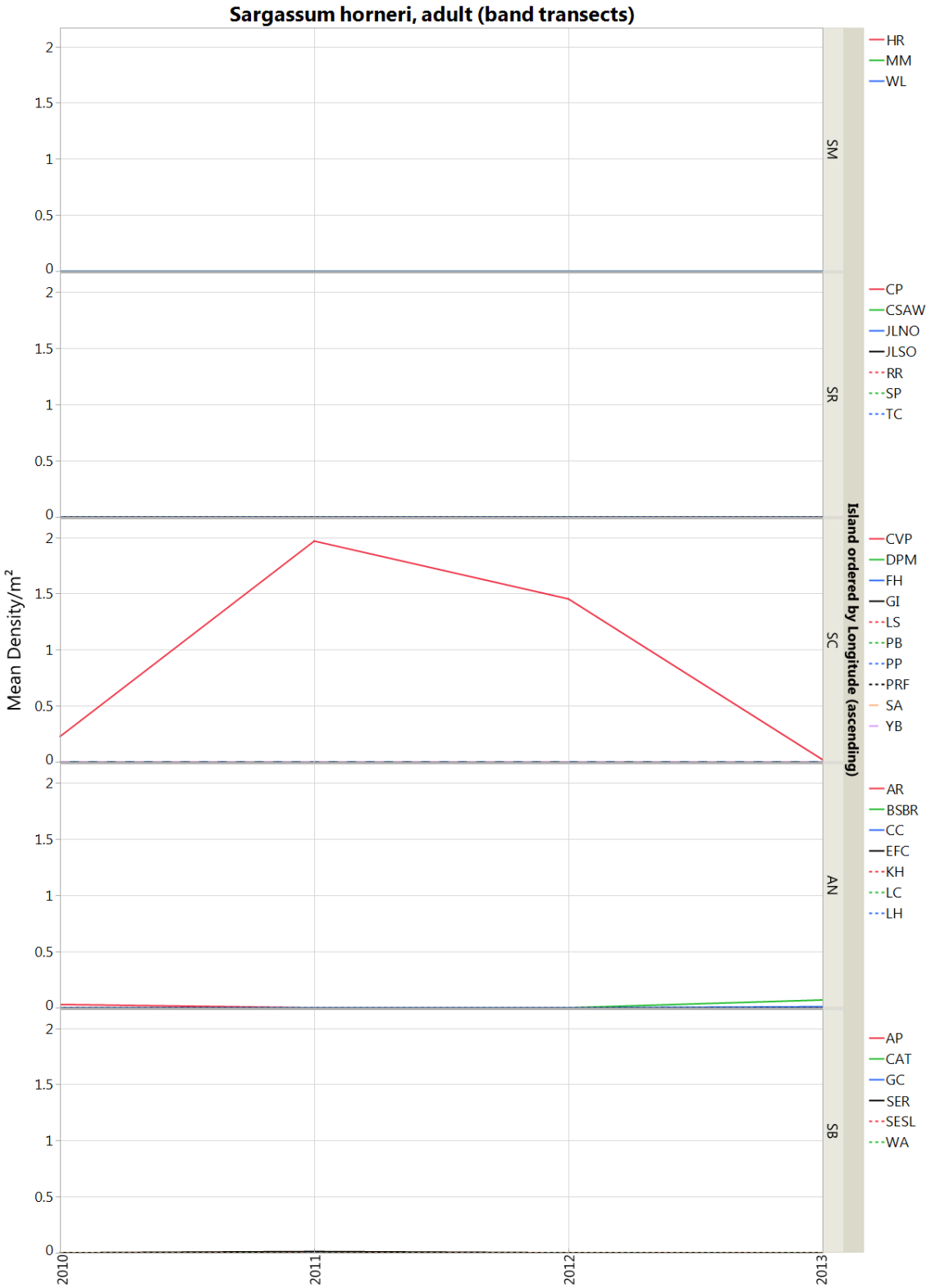

Macrocystis pyrifera, adult (5 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0.00
0.25
0.50
0.75
1.00
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

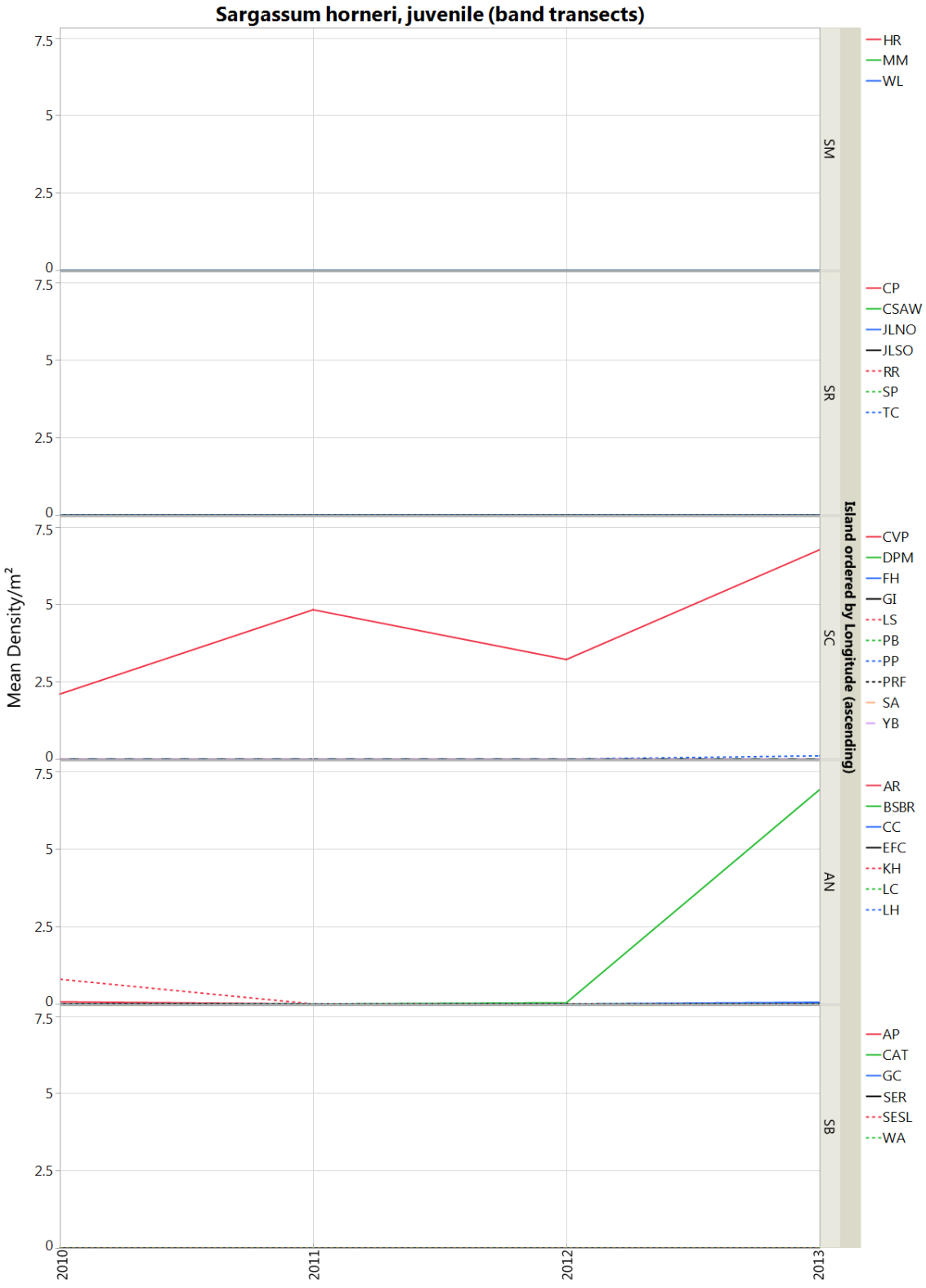

Macrocystis pyrifera, subadult (5 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0
1
2
3
4
5
6
7
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

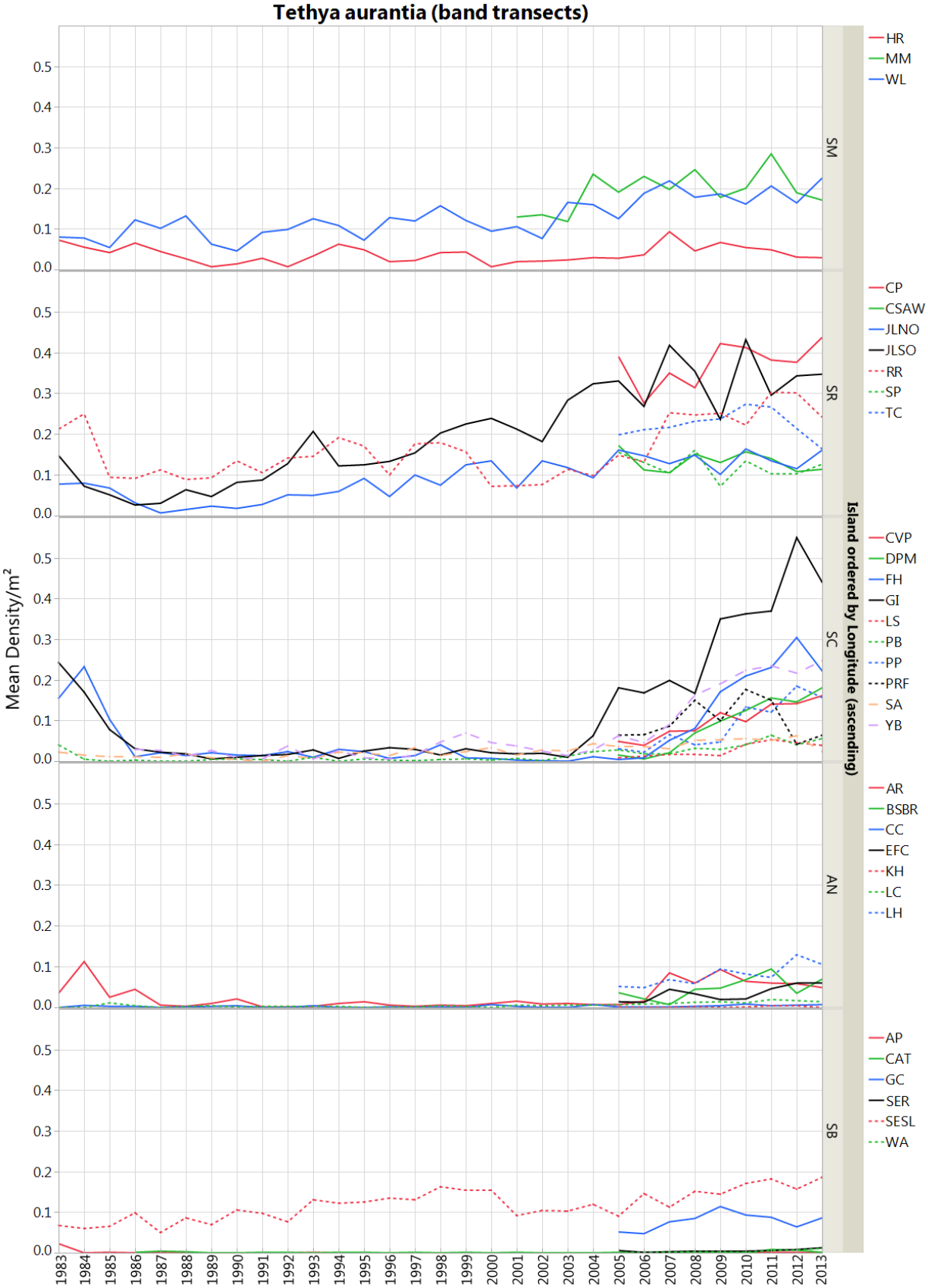

Sargassum horneri, adult (5 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0
1
2
3
4
5
2010
2011
2012
2013

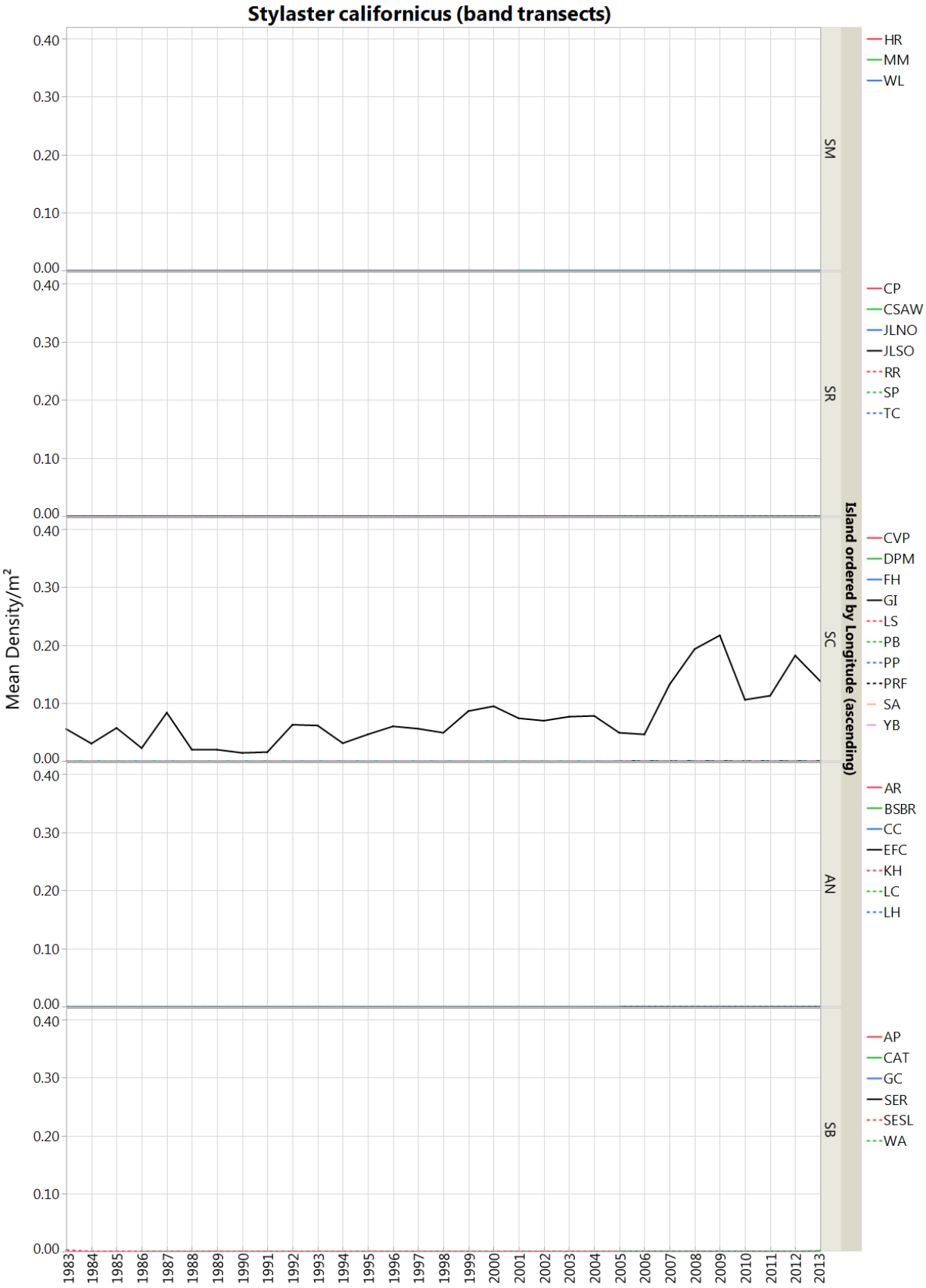

Sargassum horneri, juvenile (5 m² quadrats)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0
3
5
8
10
2010
2011
2012
2013

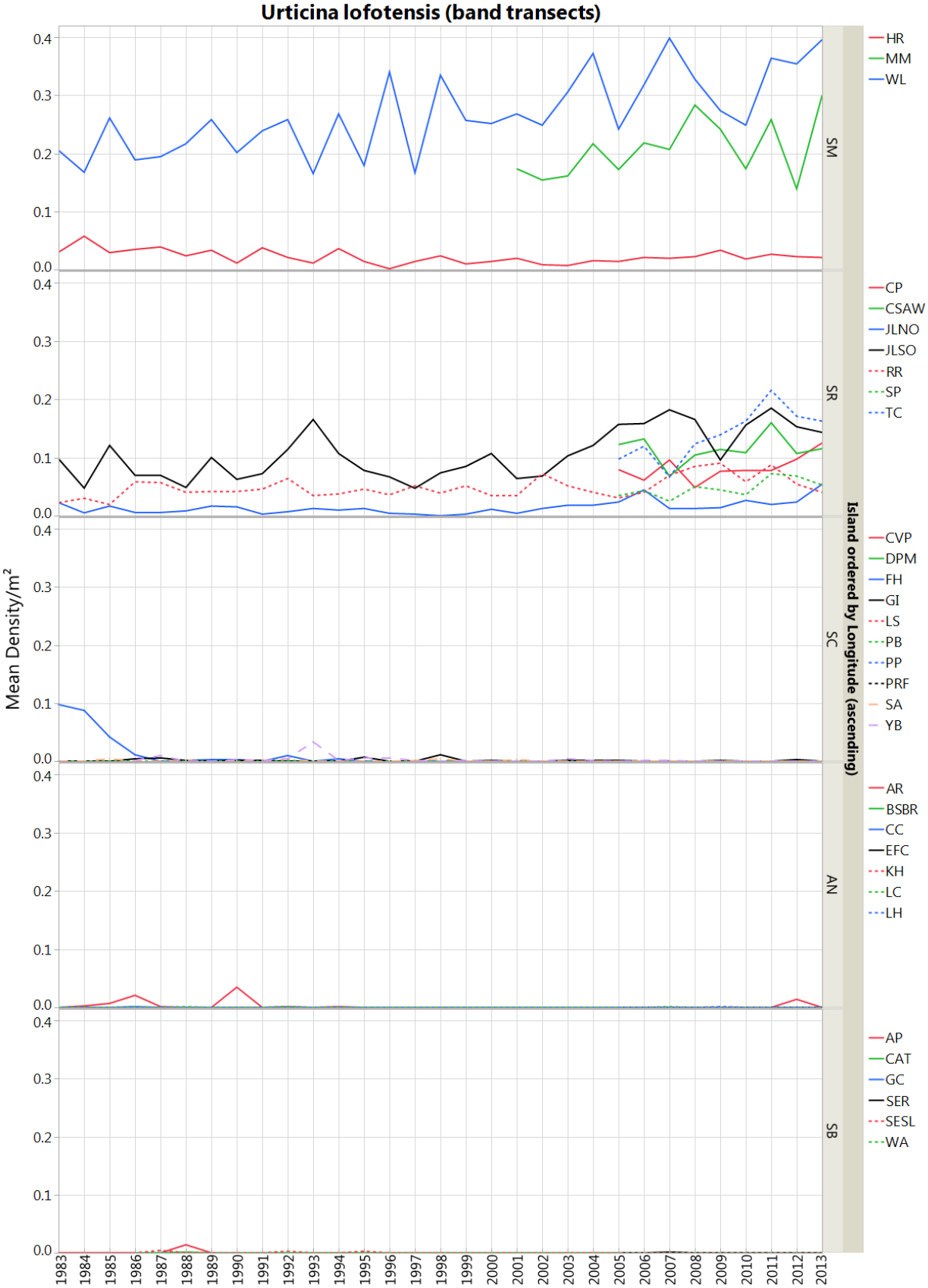
Appendix G. Band Transect Data

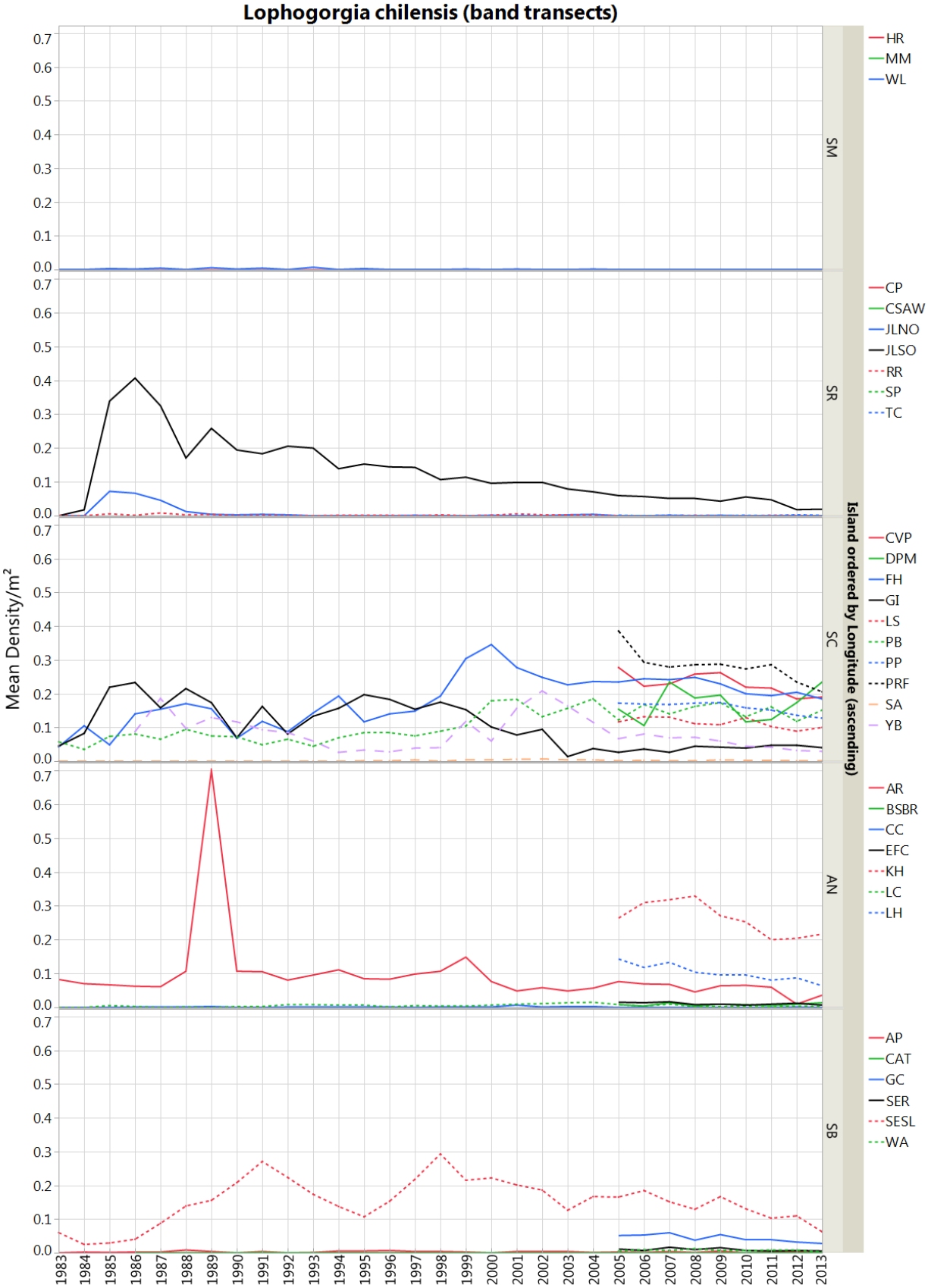


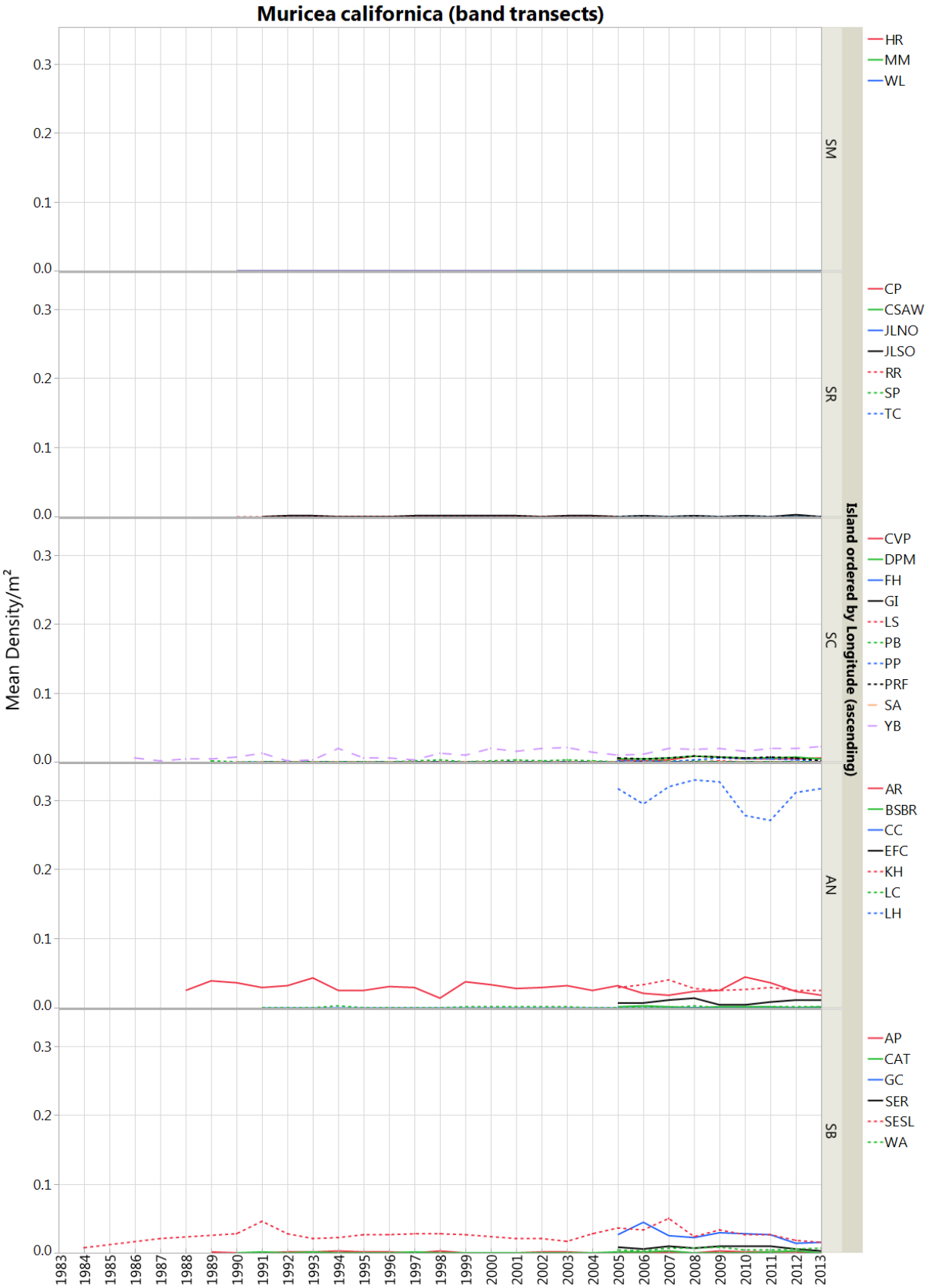

Sargassum horneri, juvenile (band transects)
Mean Density/m²
7.5
5
2.5
0
2010
2011
2012
2013
SM
SR
SC
AN
SB
Island ordered by Longitude (ascending)
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
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YB
AR
BSBR
CC
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KH
LC
LH
AP
CAT
GC
SER
SESL
WA

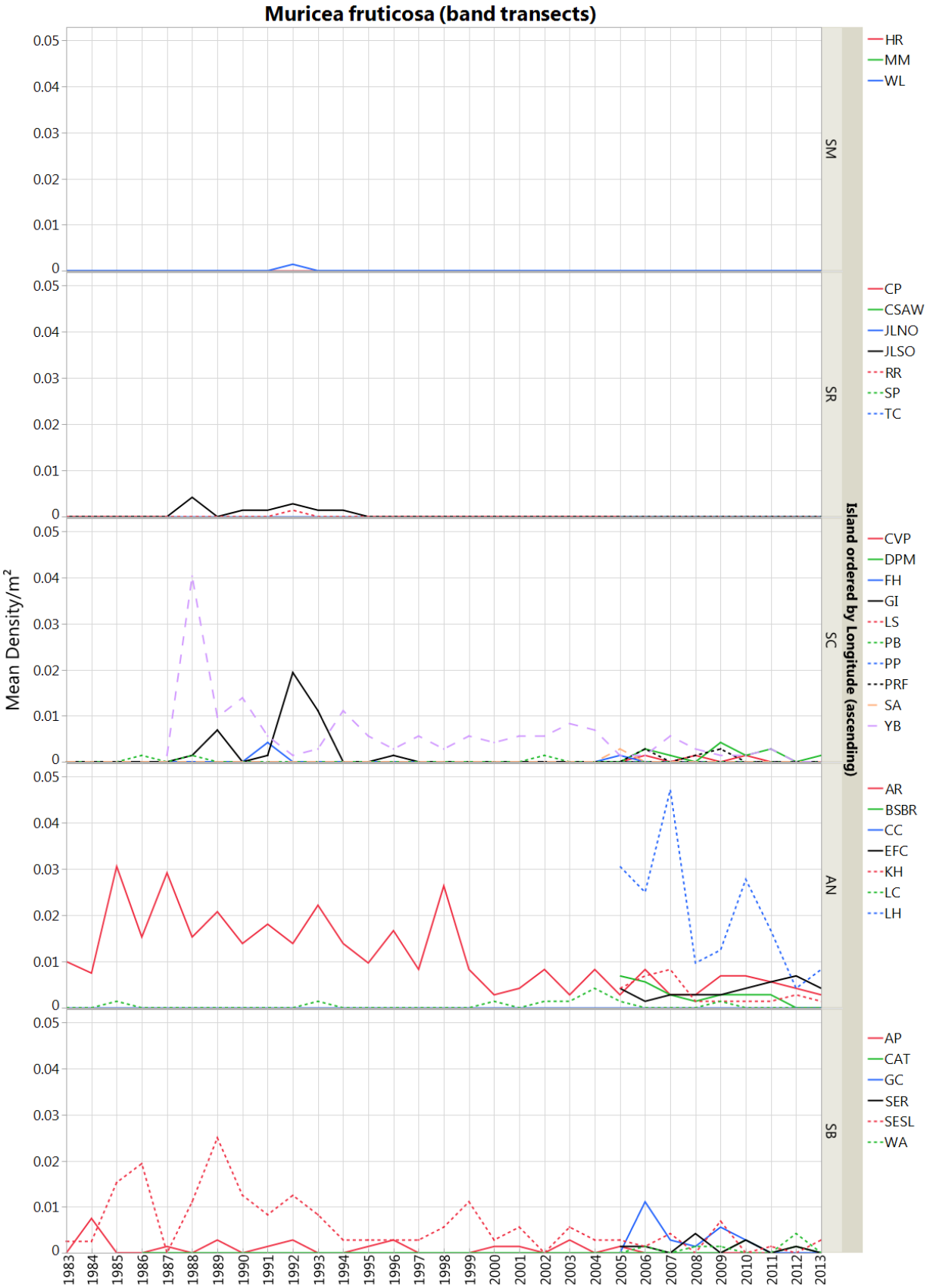

Tethya aurantia (band transects)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0.0
0.1
0.2
0.3
0.4
0.5
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
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1999
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2001
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2007
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2010
2011
2012
2013

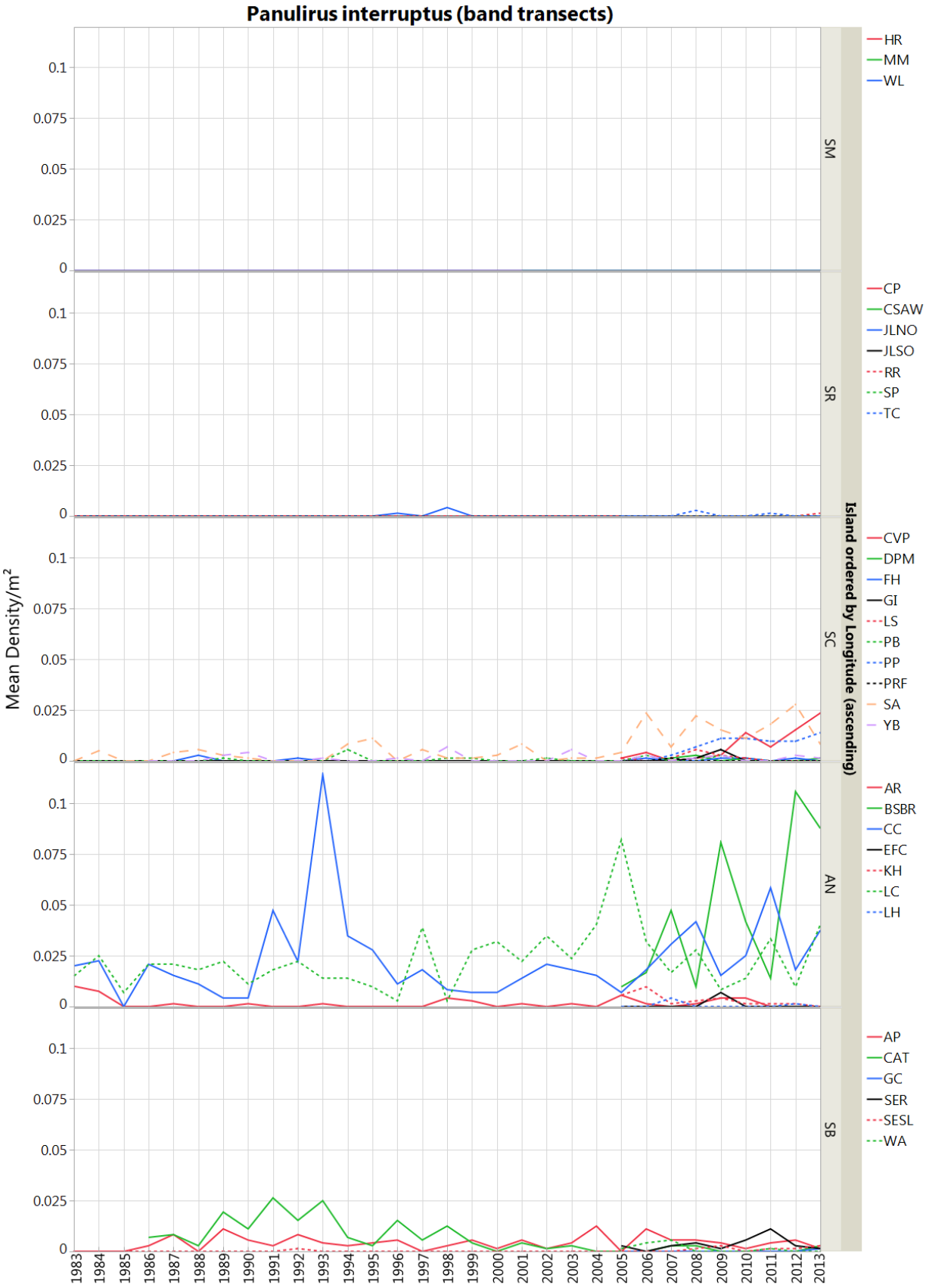

Stylaster californicus (band transects)
Mean Density/m²
0.40
0.30
0.20
0.10
0.00
SM
SR
SC
AN
SB
Island ordered by Longitude (ascending)
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
1983
1984
1985
1986
1987
1988
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2011
2012
2013

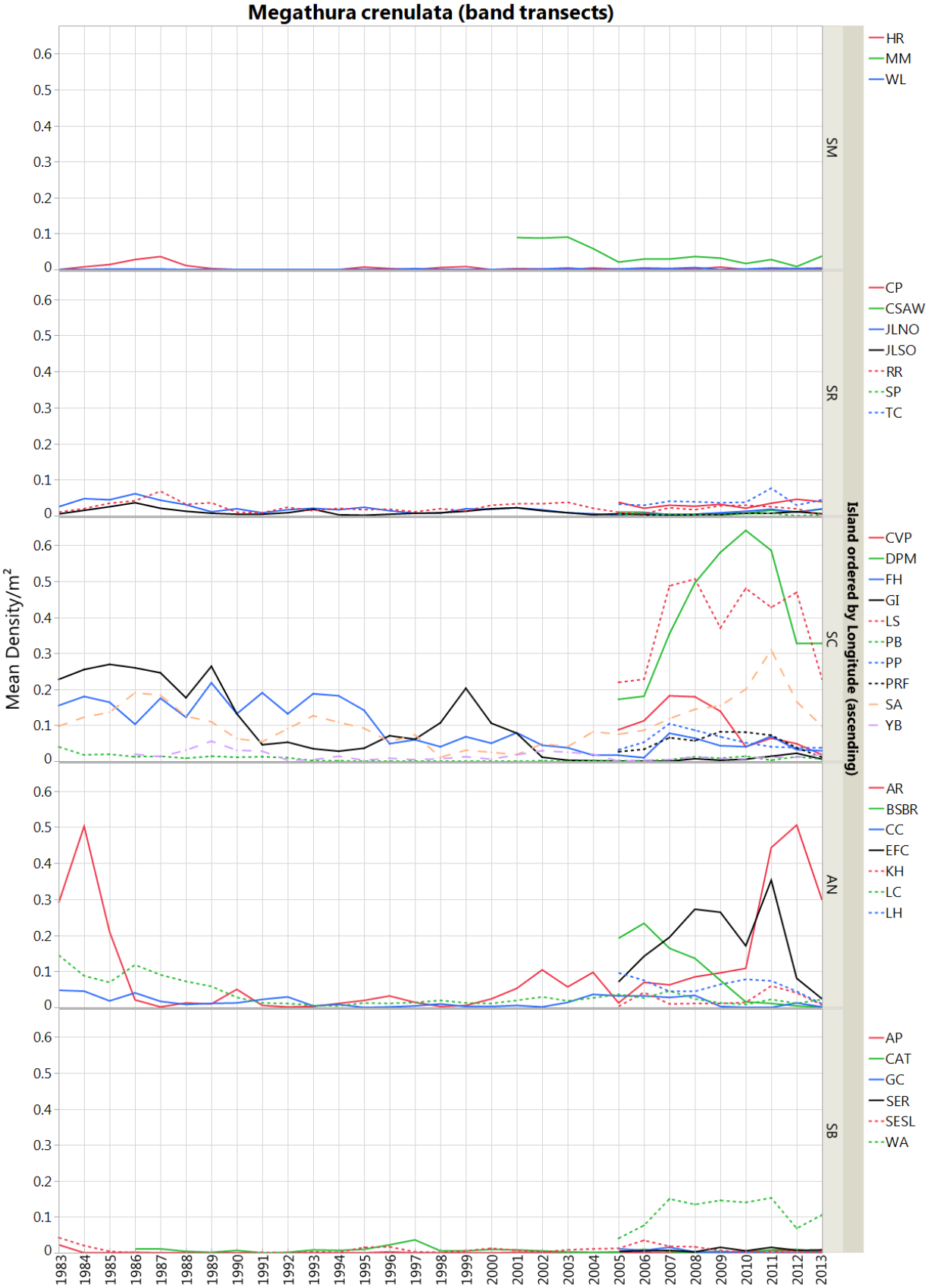

Urticina lofotensis (band transects)
Mean Density/m²
0.0
0.1
0.2
0.3
0.4
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
Island ordered by Longitude (ascending)
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
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1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

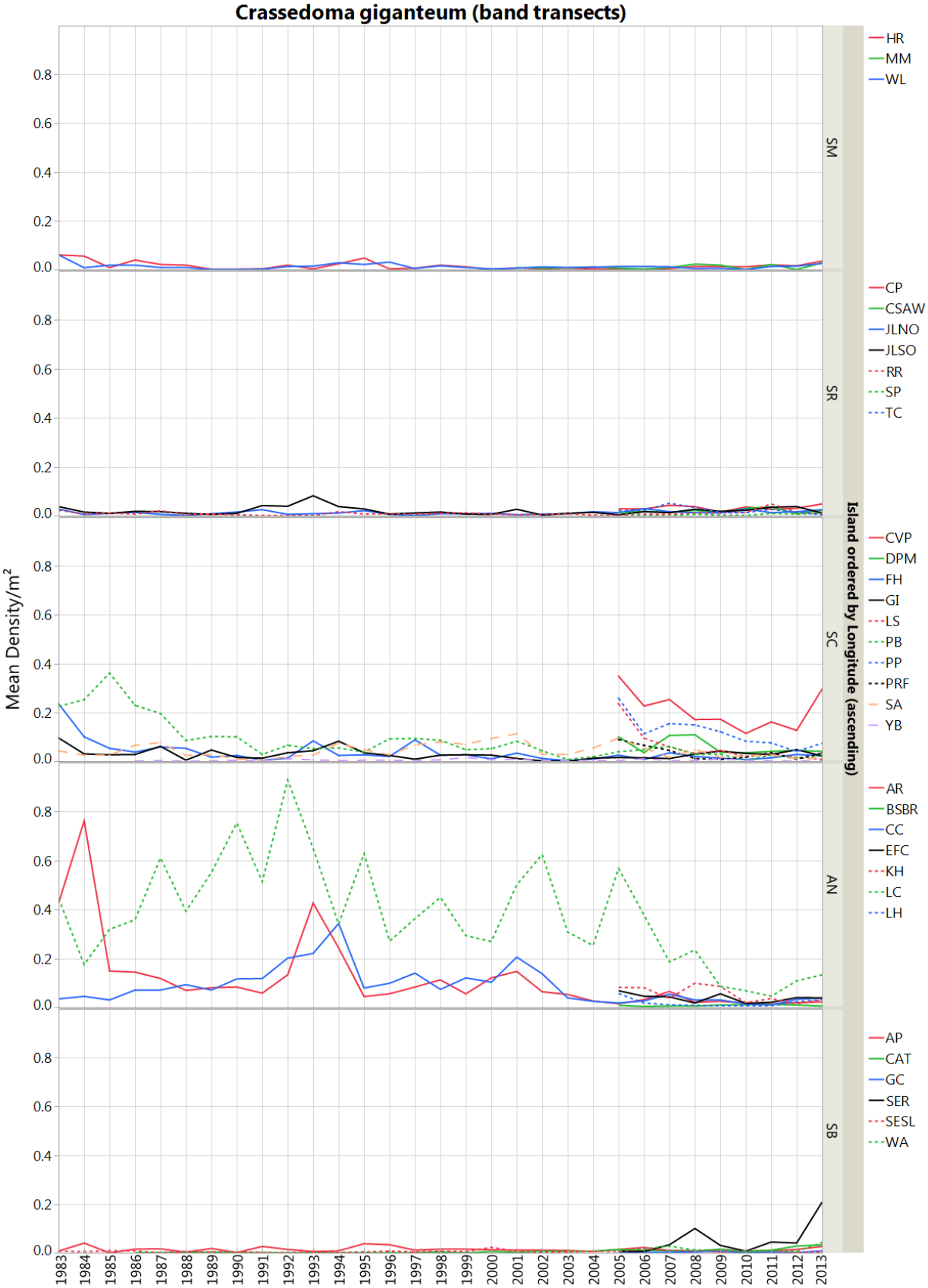

Lophogorgia chilensis (band transects)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
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1996
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2004
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2009
2010
2011
2012
2013

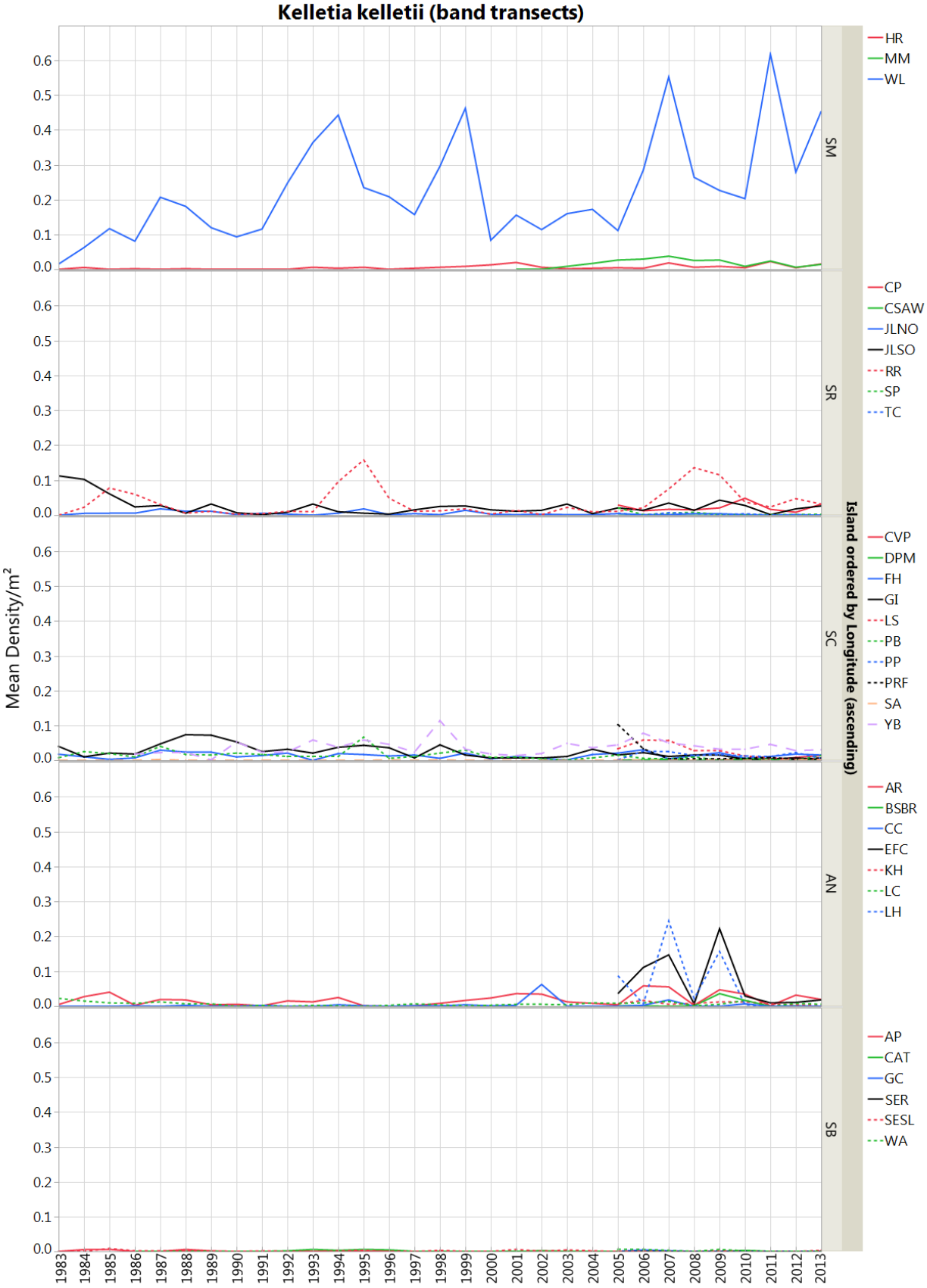

Muricea californica (band transects)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0.0
0.1
0.2
0.3
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
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2010
2011
2012
2013

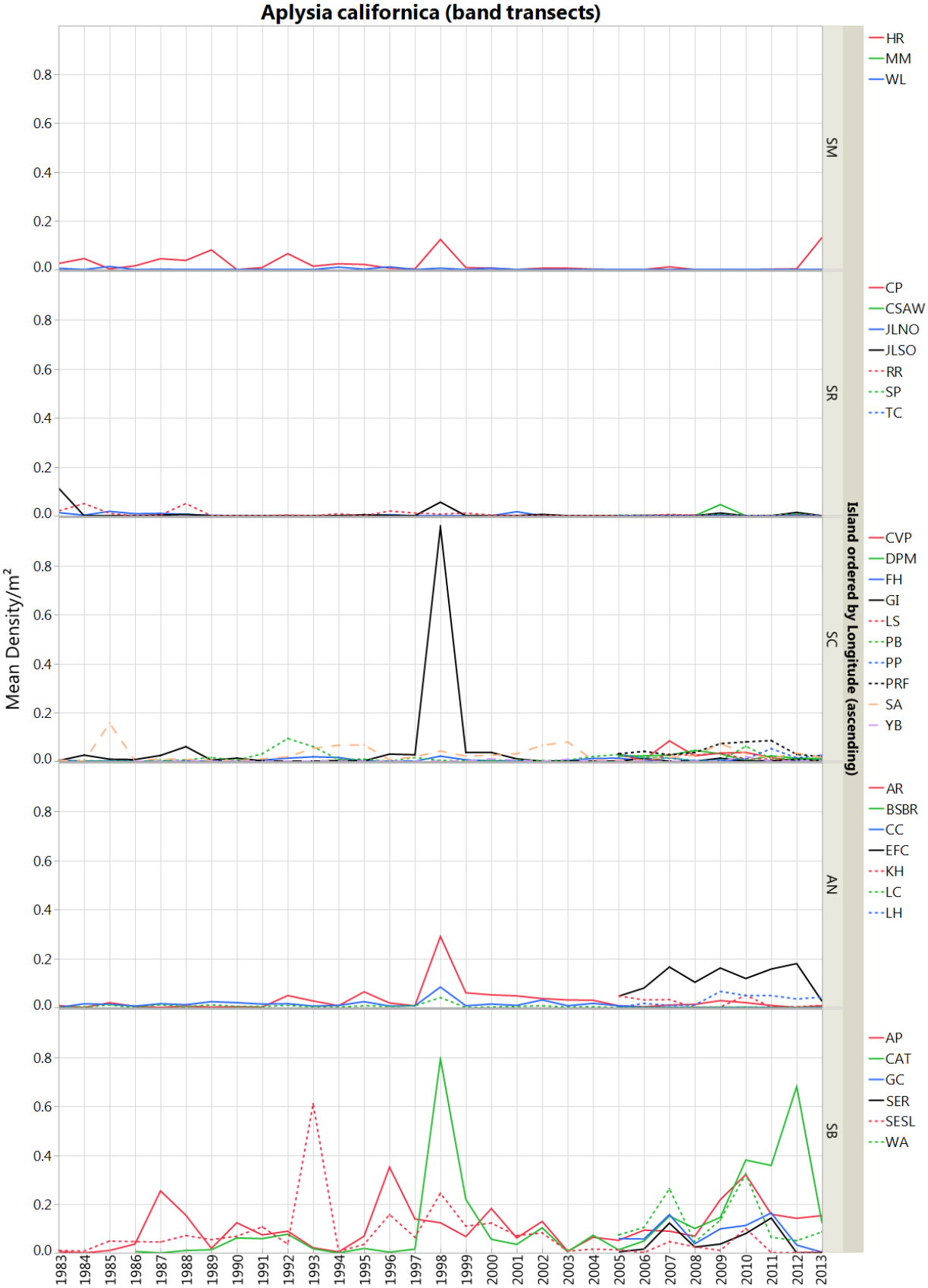

Muricea fruticosa (band transects)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0
0.01
0.02
0.03
0.04
0.05
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
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2008
2009
2010
2011
2012
2013

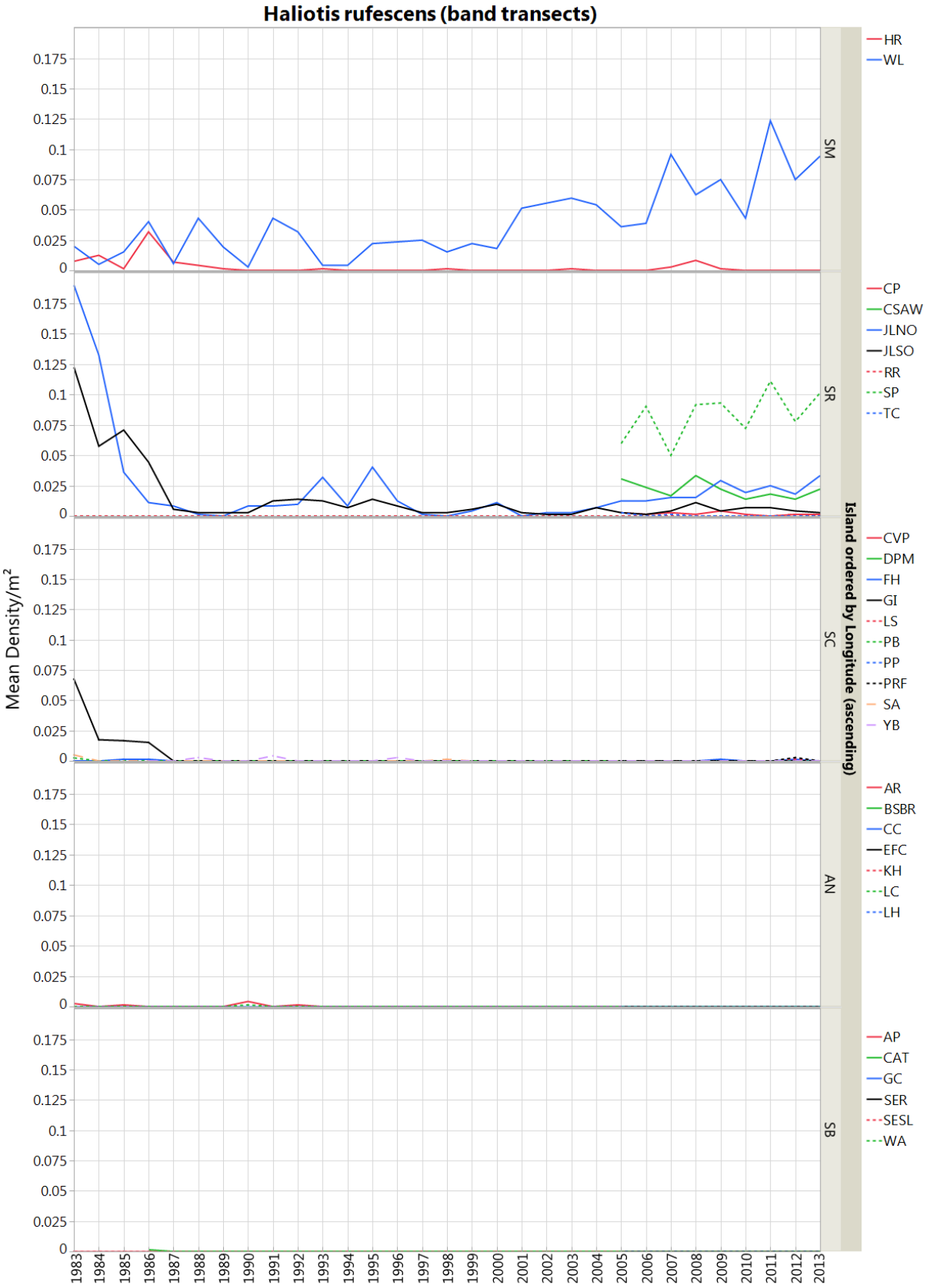

Panulirus interruptus (band transects)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0
0.025
0.05
0.075
0.1
1983
1984
1985
1986
1987
1988
1989
1990
1991
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1993
1994
1995
1996
1997
1998
1999
2000
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2002
2003
2004
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2006
2007
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2009
2010
2011
2012
2013

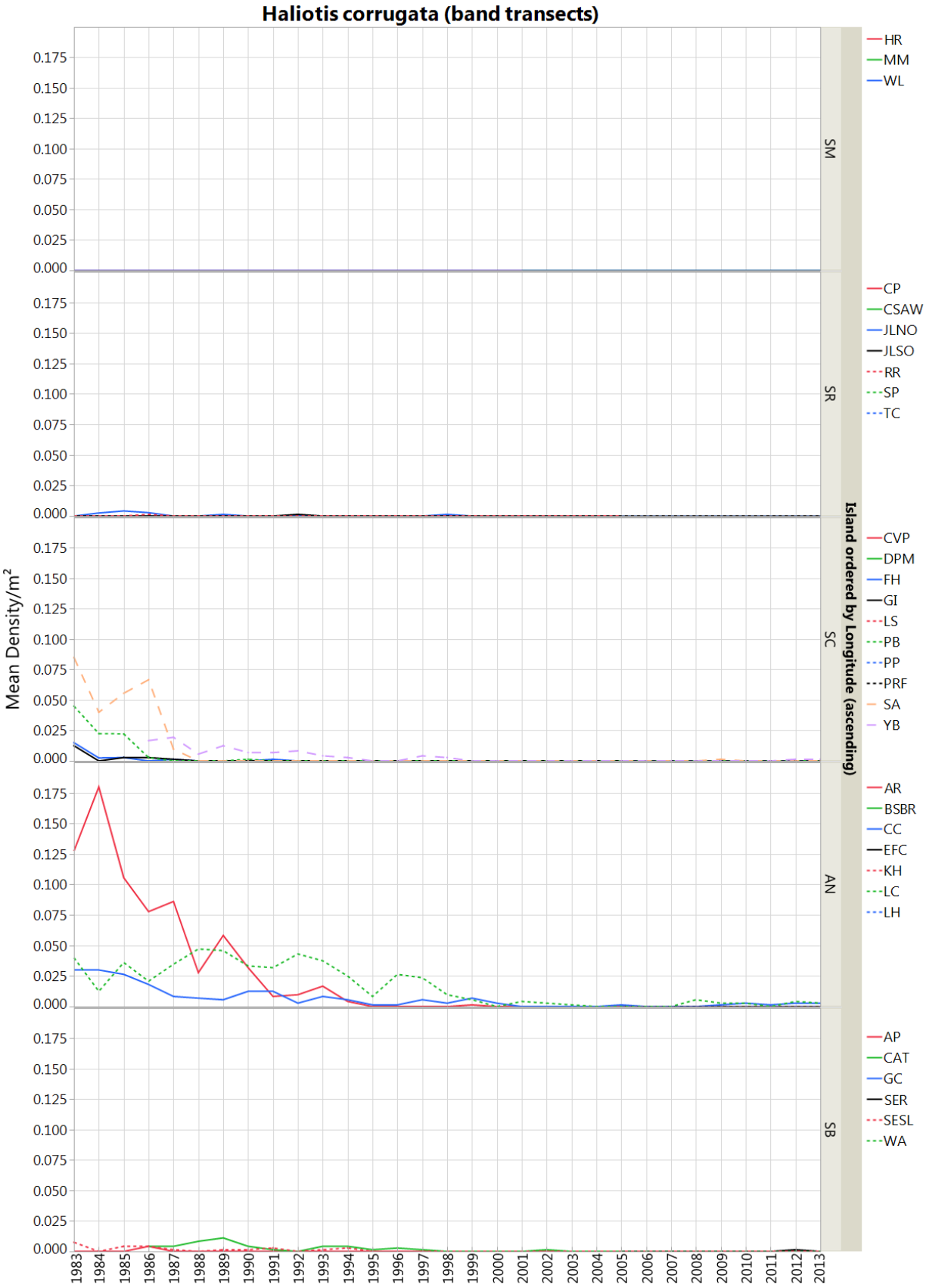

Megathura crenulata (band transects)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0
0.1
0.2
0.3
0.4
0.5
0.6
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
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1995
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2002
2003
2004
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2010
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2012
2013

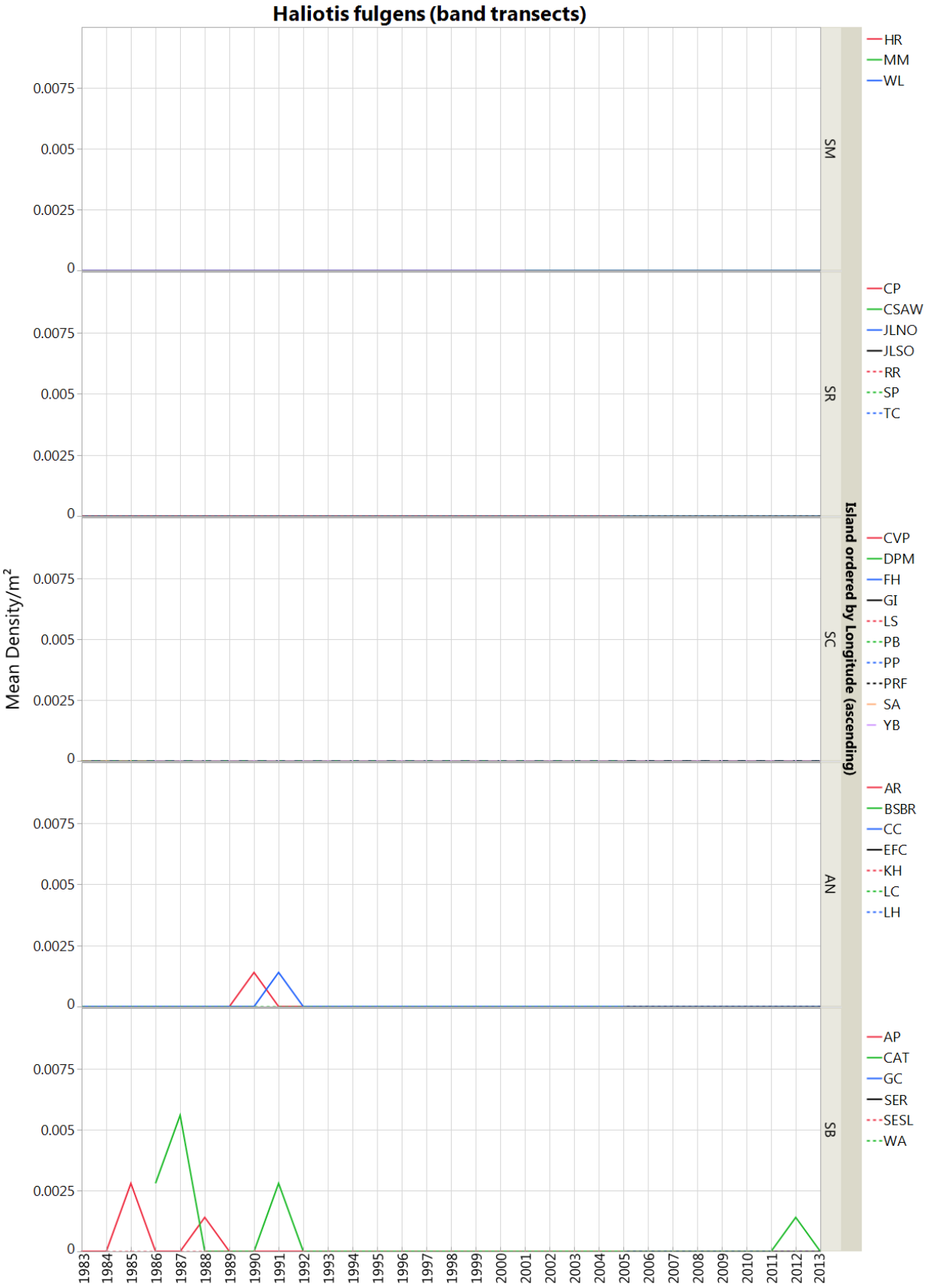

Crassedoma giganteum (band transects)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0.0
0.2
0.4
0.6
0.8
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
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2010
2011
2012
2013

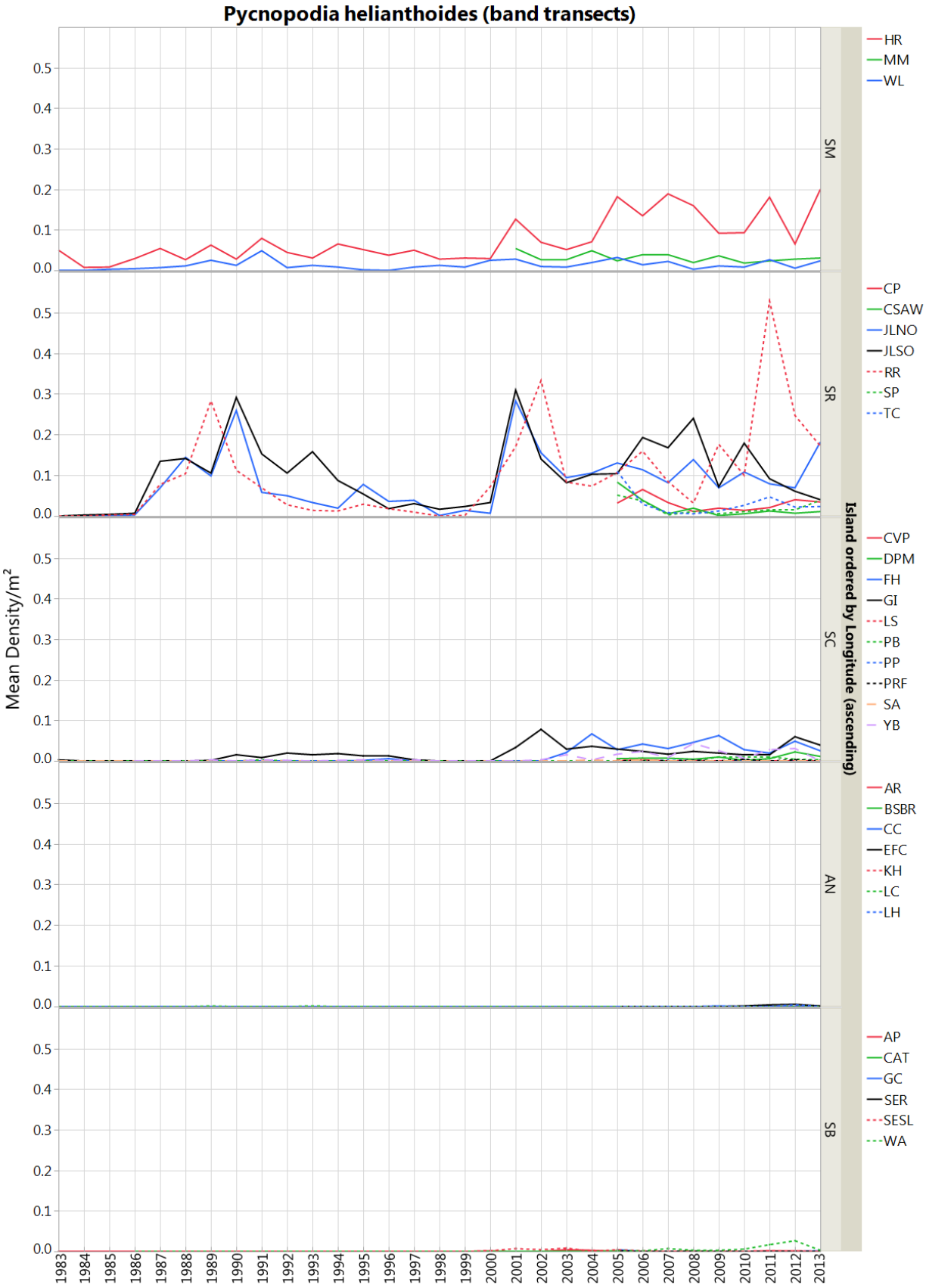

Kelletia kelletii (band transects)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0.0
0.1
0.2
0.3
0.4
0.5
0.6
1983
1984
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1989
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2010
2011
2012
2013

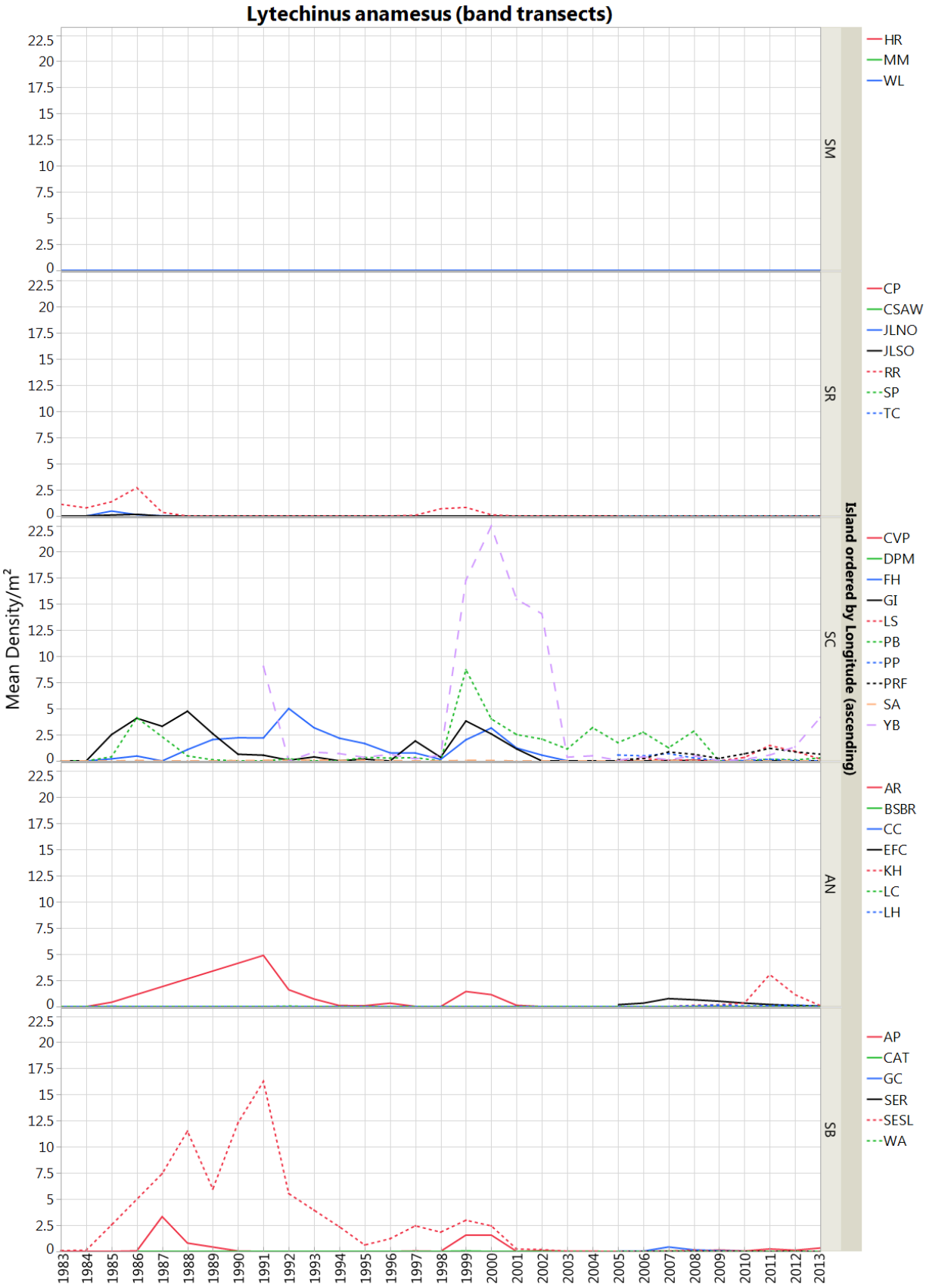

Aplysia californica (band transects)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0.0
0.2
0.4
0.6
0.8
1983
1984
1985
1986
1987
1988
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1997
1998
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2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013


Haliotis rufescens (band transects)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0
0.025
0.05
0.075
0.1
0.125
0.15
0.175
1983
1984
1985
1986
1987
1988
1989
1990
1991
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1996
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1998
1999
2000
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2002
2003
2004
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2006
2007
2008
2009
2010
2011
2012
2013

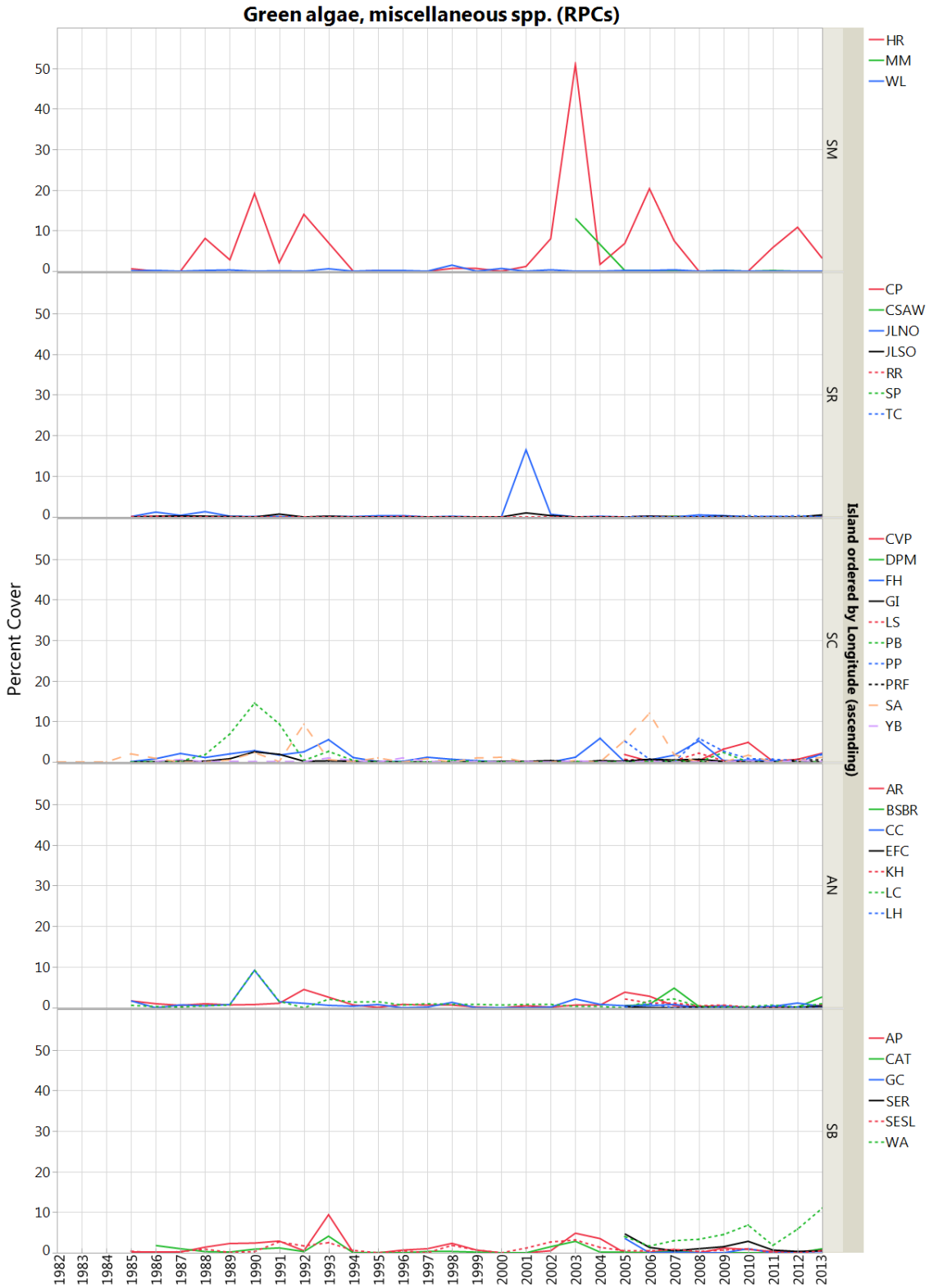

Haliotis corrugata (band transects)
Mean Density/m²
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
Island ordered by Longitude (ascending)
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
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2006
2007
2008
2009
2010
2011
2012
2013

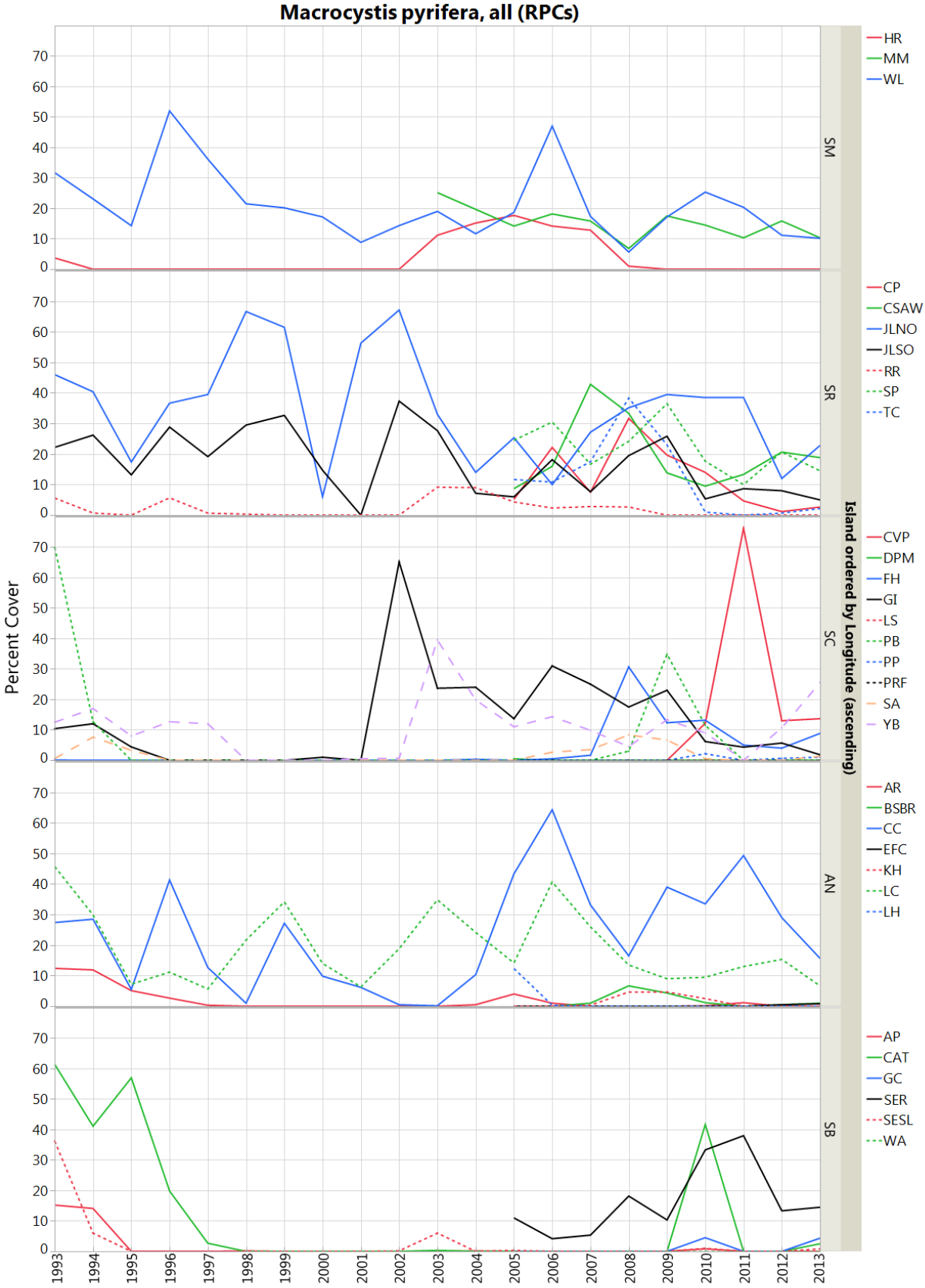

Haliotis fulgens (band transects)
Mean Density/m²
0.0075
0.005
0.0025
0
SM
SR
SC
AN
SB
Island ordered by Longitude (ascending)
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
1983
1984
1985
1986
1987
1988
1989
1990
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1992
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2010
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2012
2013

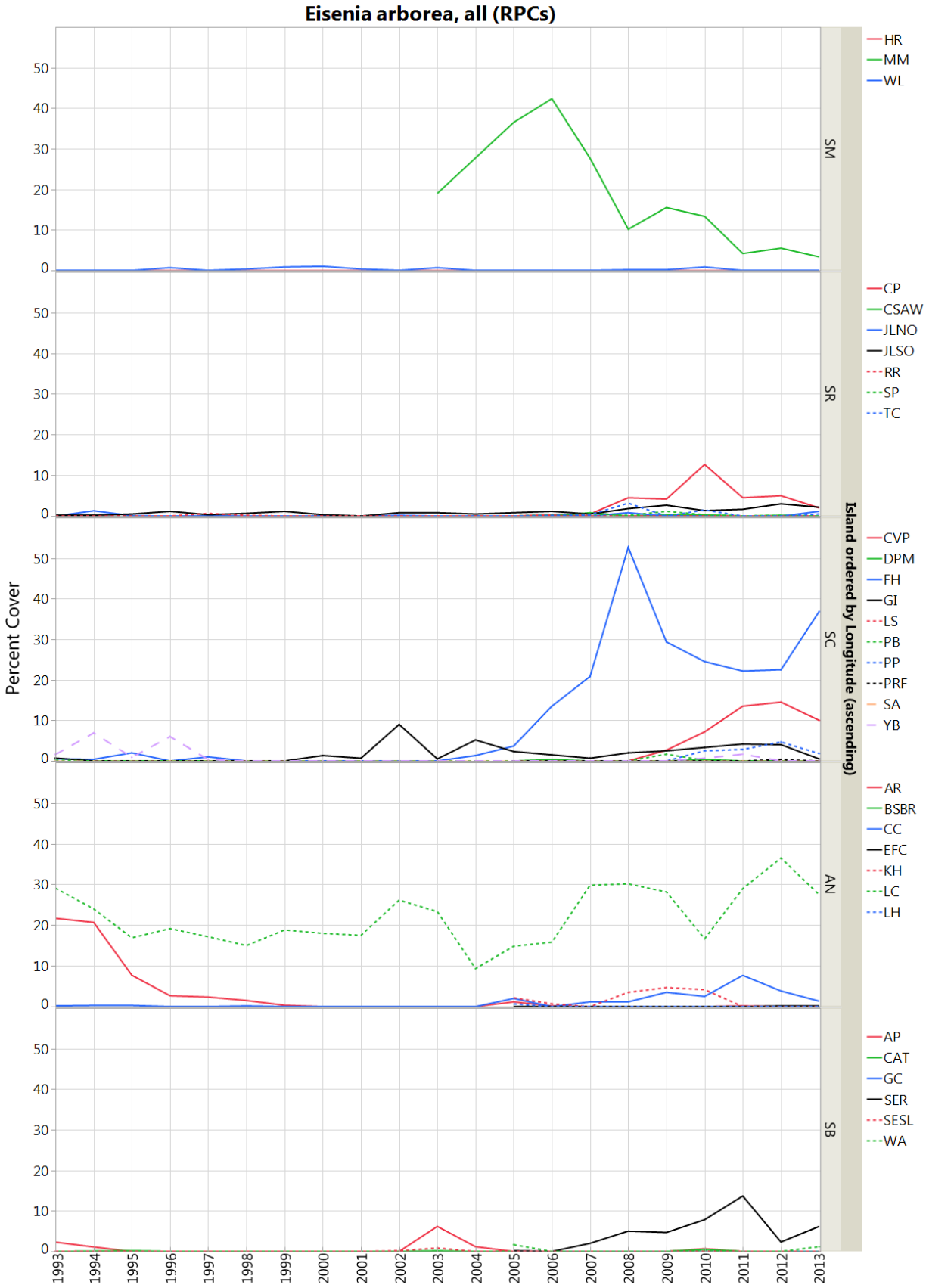

Pycnopodia helianthoides (band transects)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0.0
0.1
0.2
0.3
0.4
0.5
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
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2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

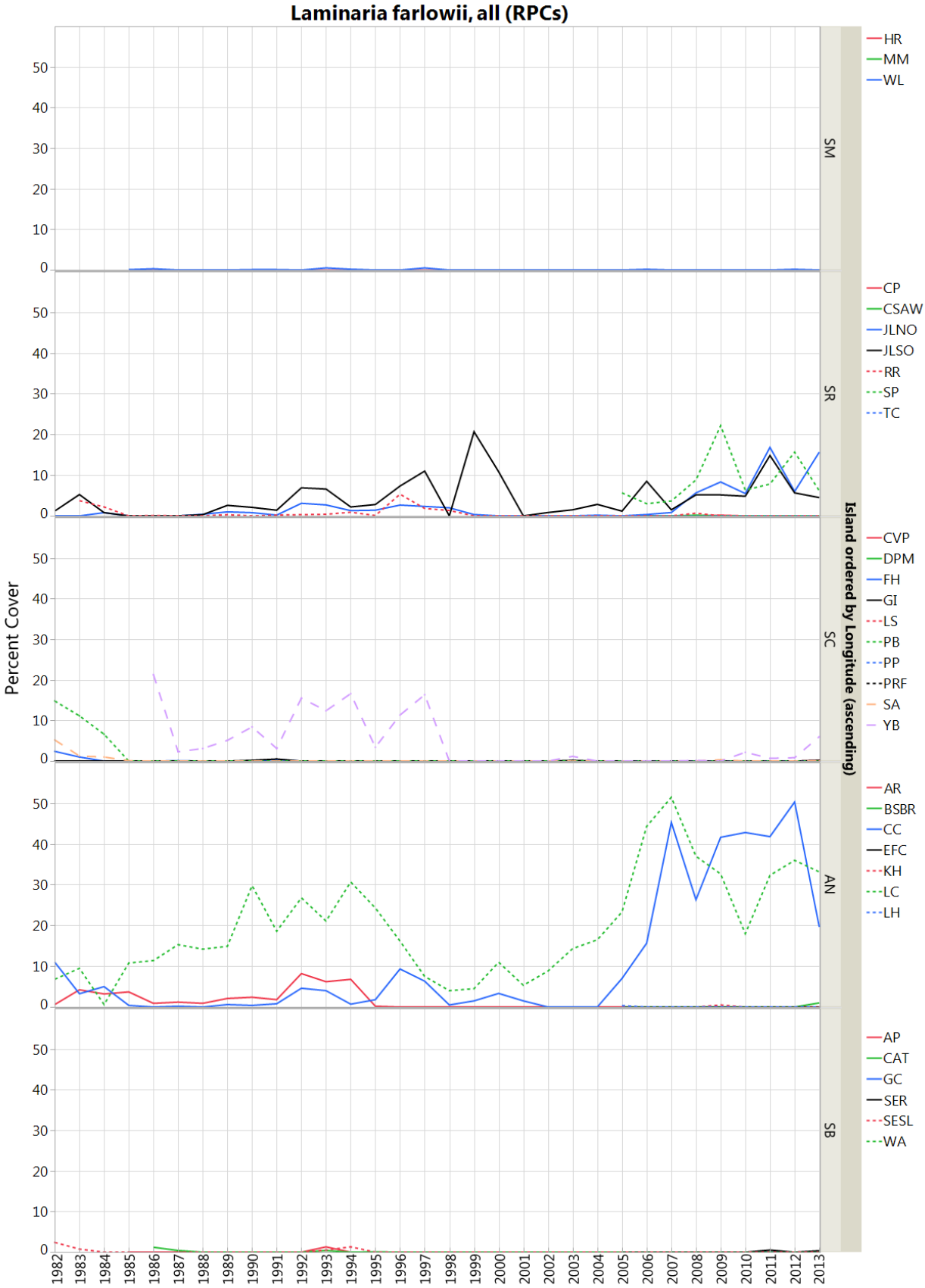

Lytechinus anamesus (band transects)
Mean Density/m²
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
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2002
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2004
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2010
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2012
2013

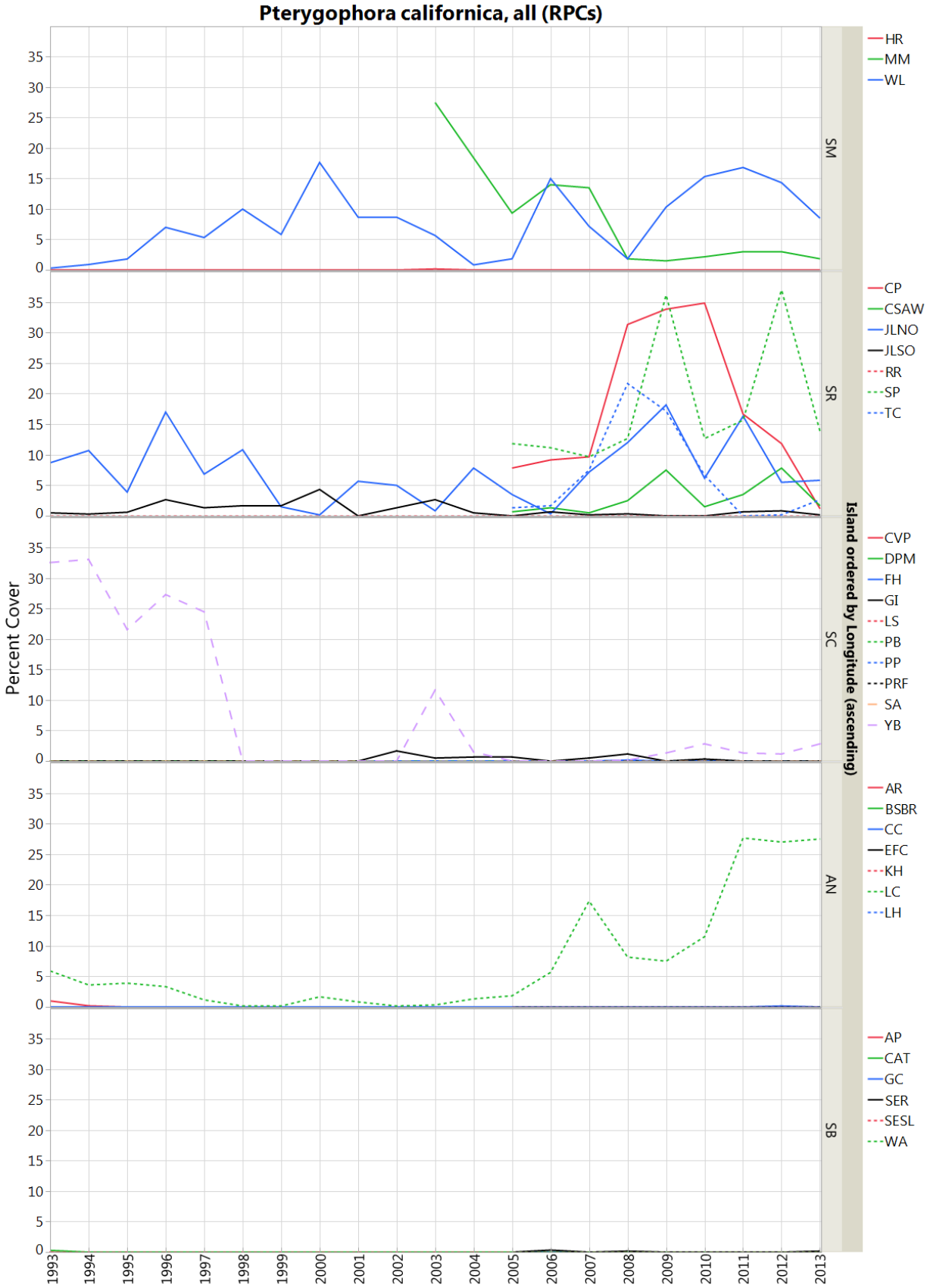
Appendix H. Random Point Contact Data

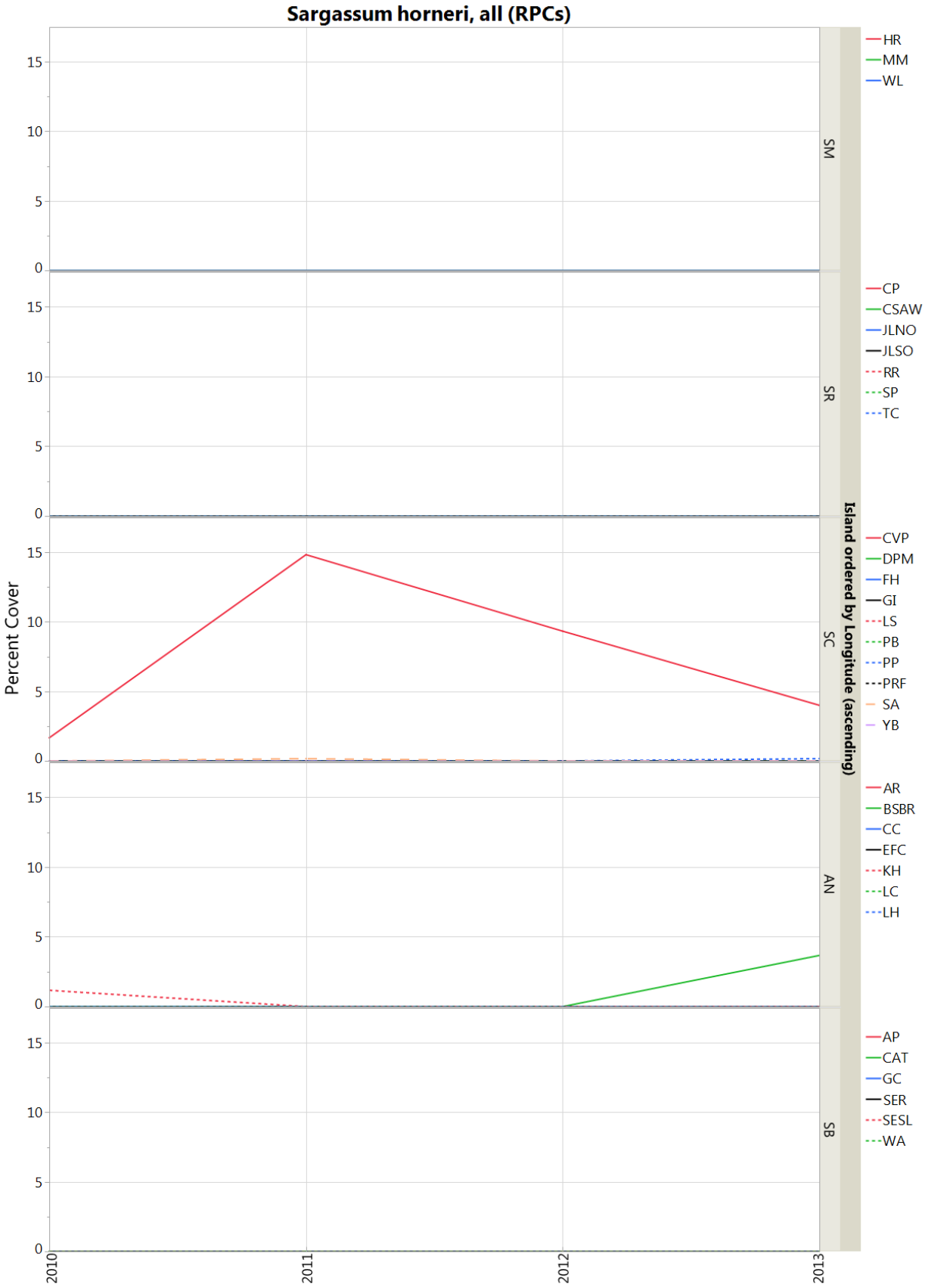


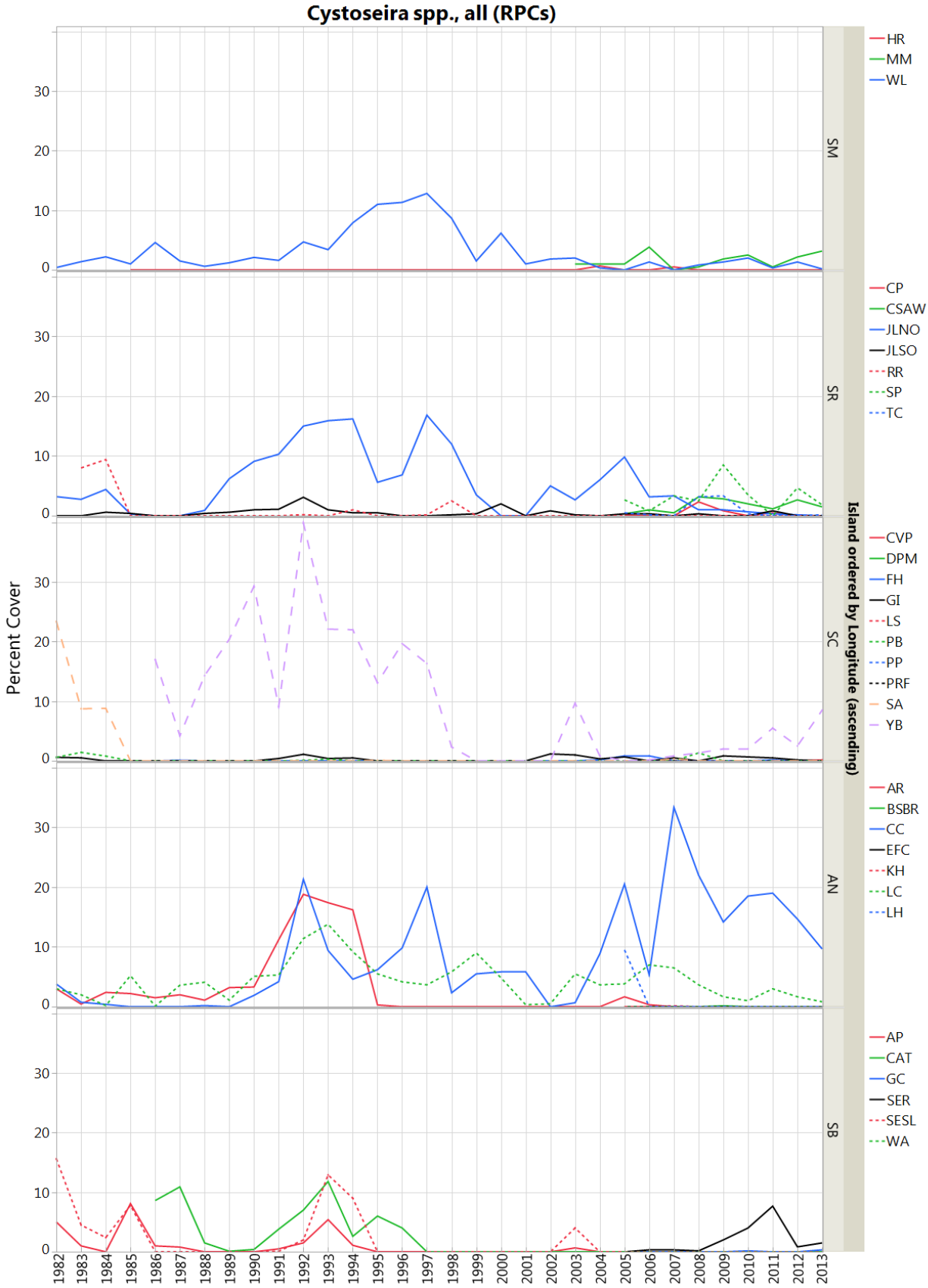

Macrocystis pyrifera, all (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0
10
20
30
40
50
60
70
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

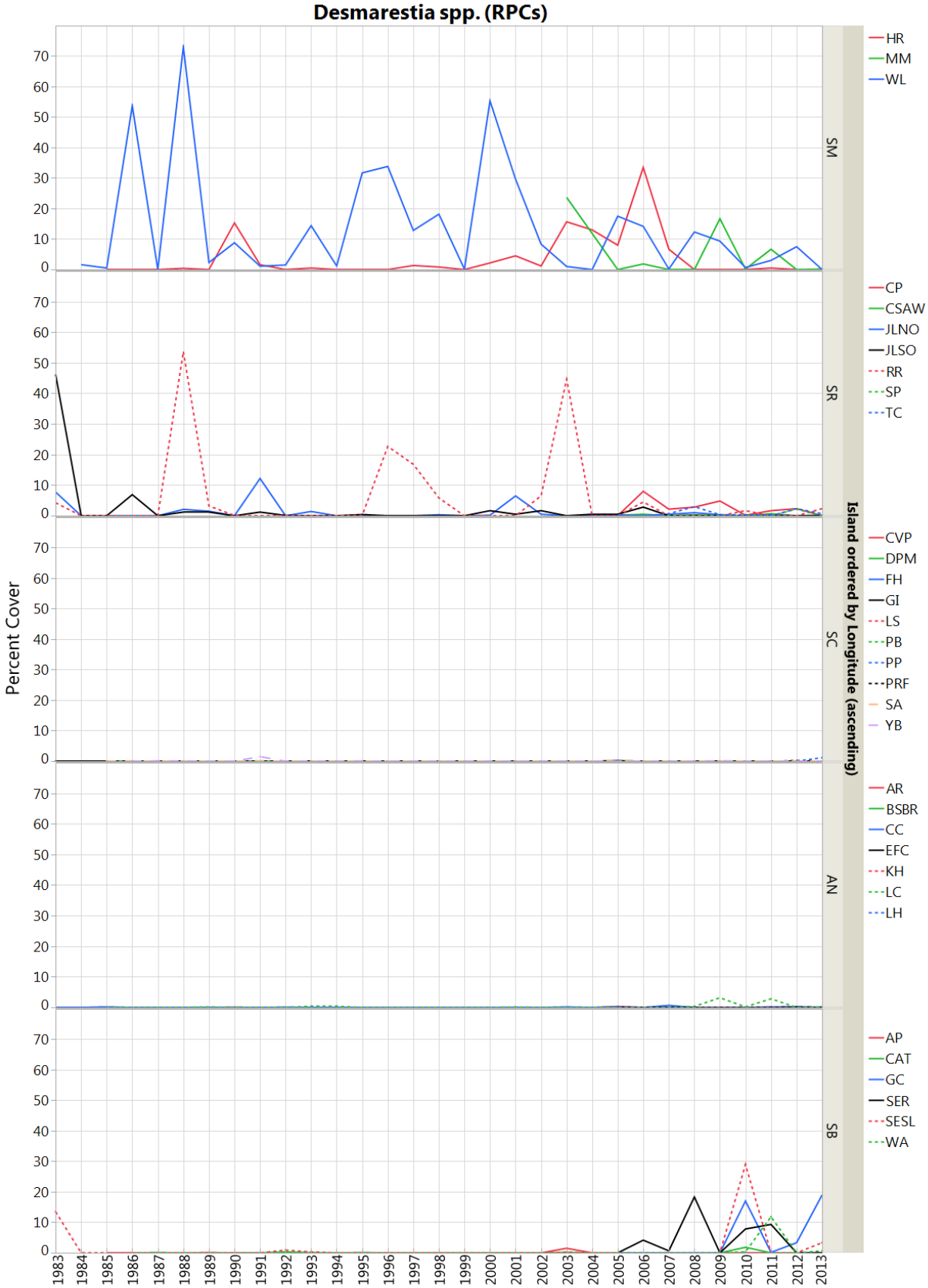

Eisenia arborea, all (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0
10
20
30
40
50
1993
1994
1995
1996
1997
1998
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2003
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2010
2011
2012
2013

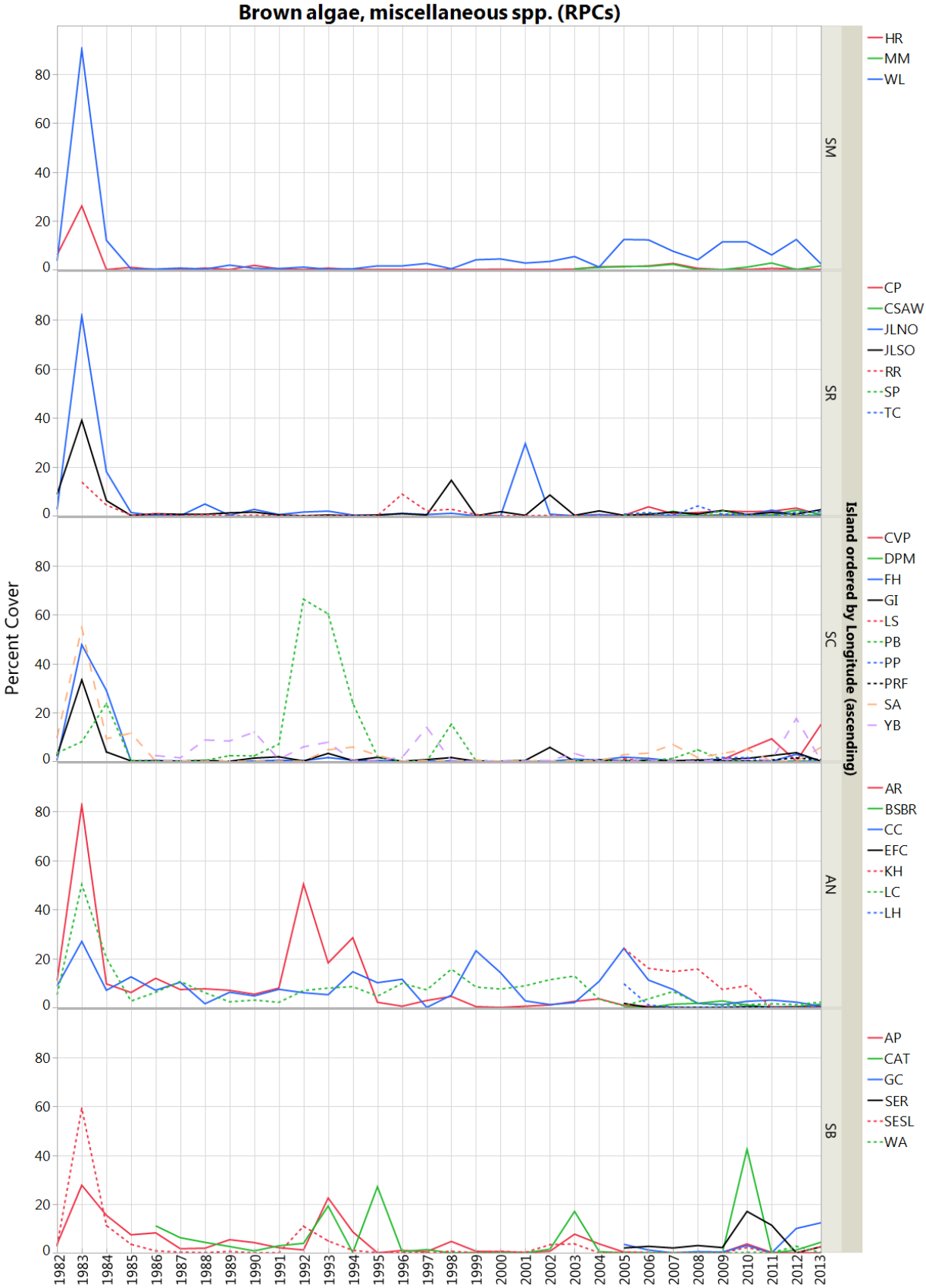

Laminaria farlowii, all (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
0
10
20
30
40
50
1982
1983
1984
1985
1986
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2012
2013

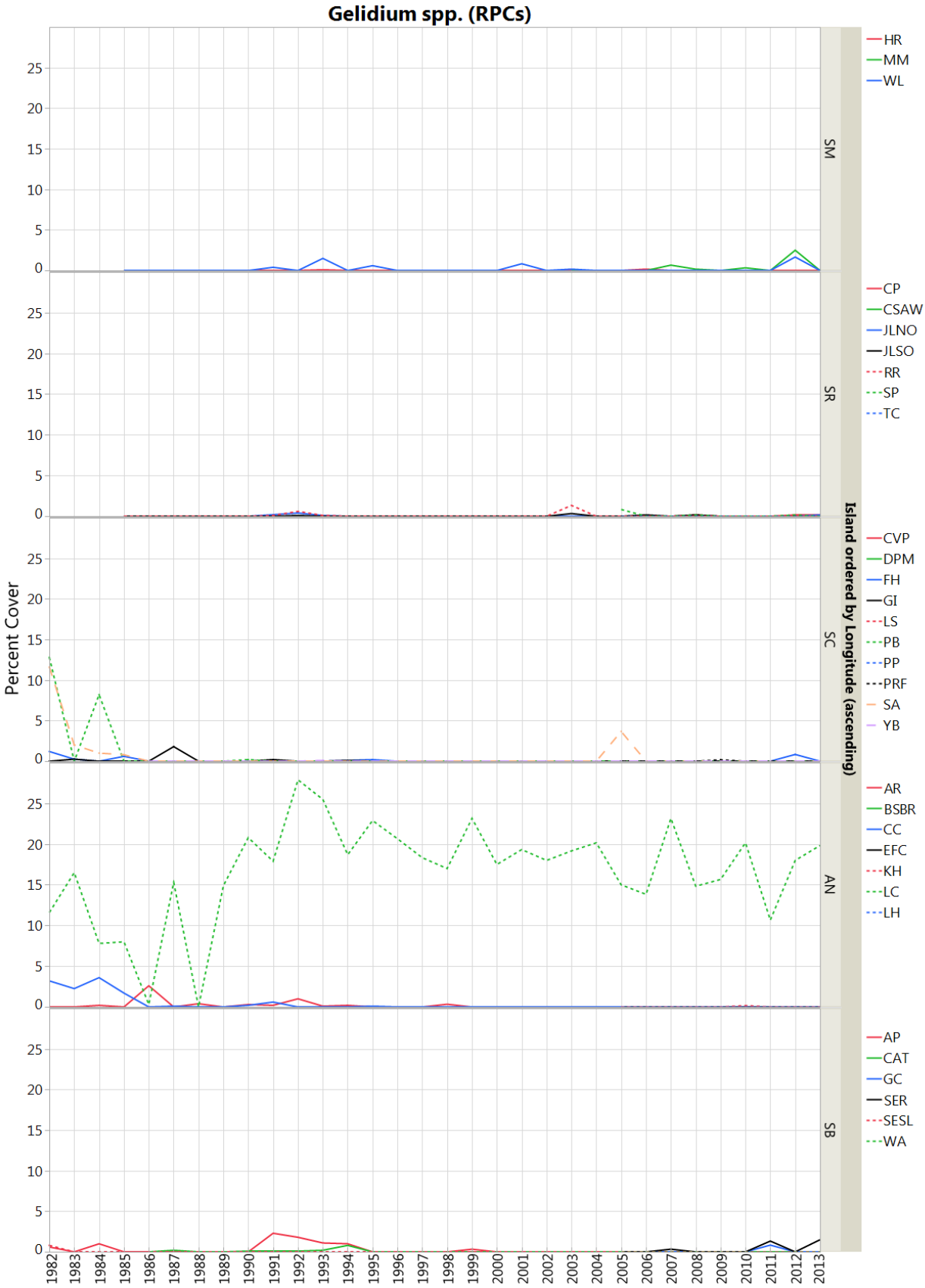

Pterygophora californica, all (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
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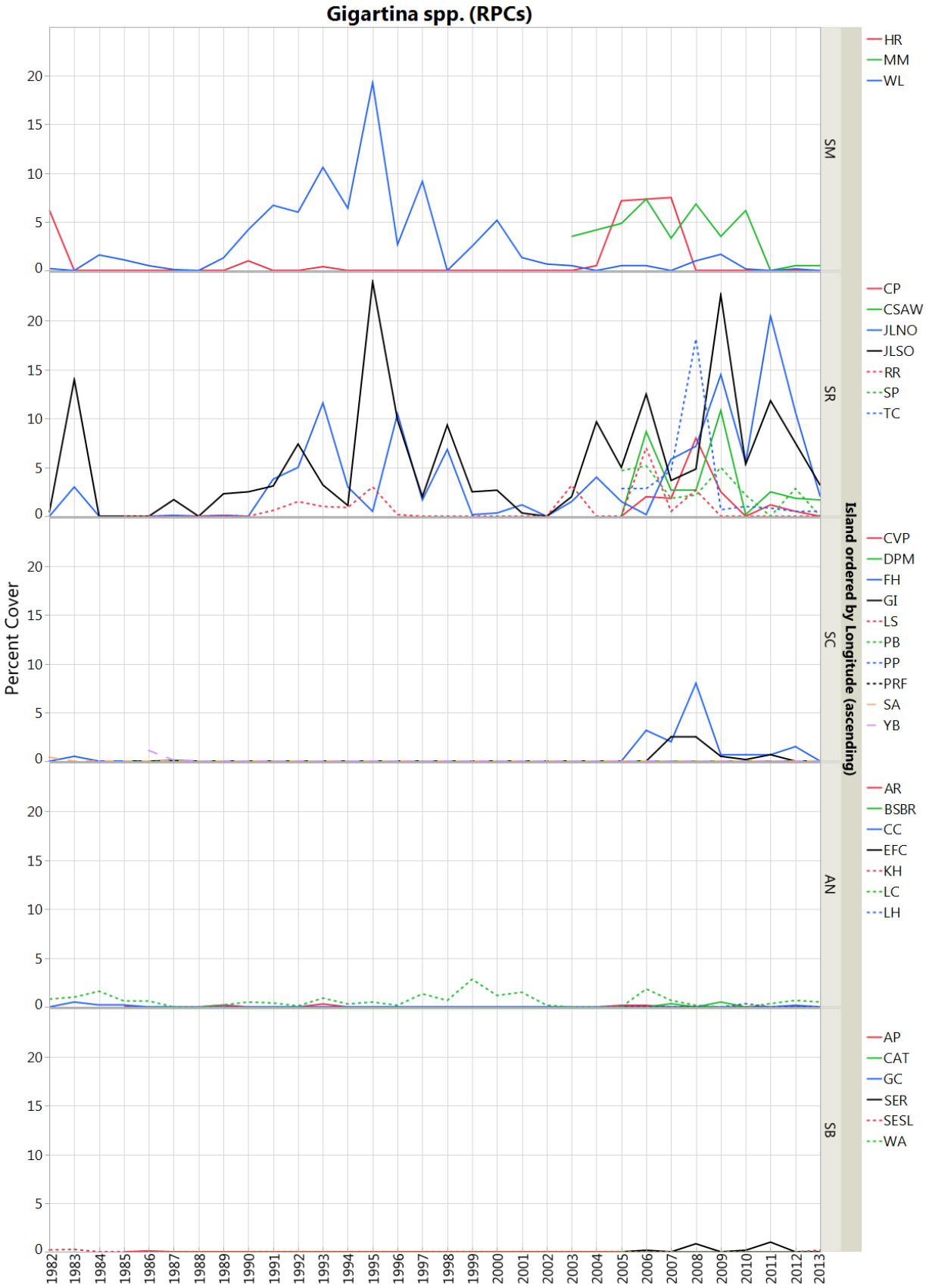

Sargassum horneri, all (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
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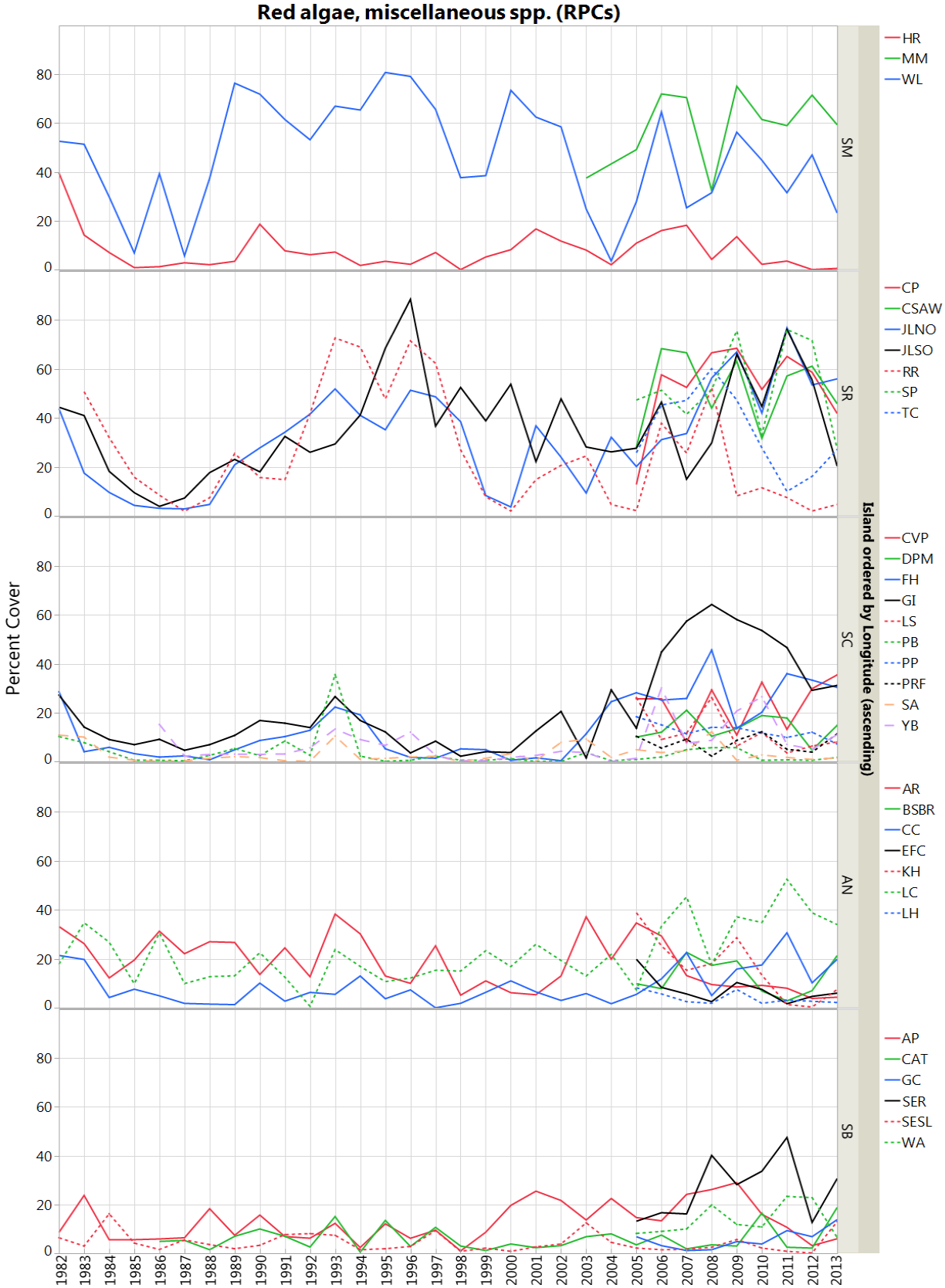

Cystoseira spp., all (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
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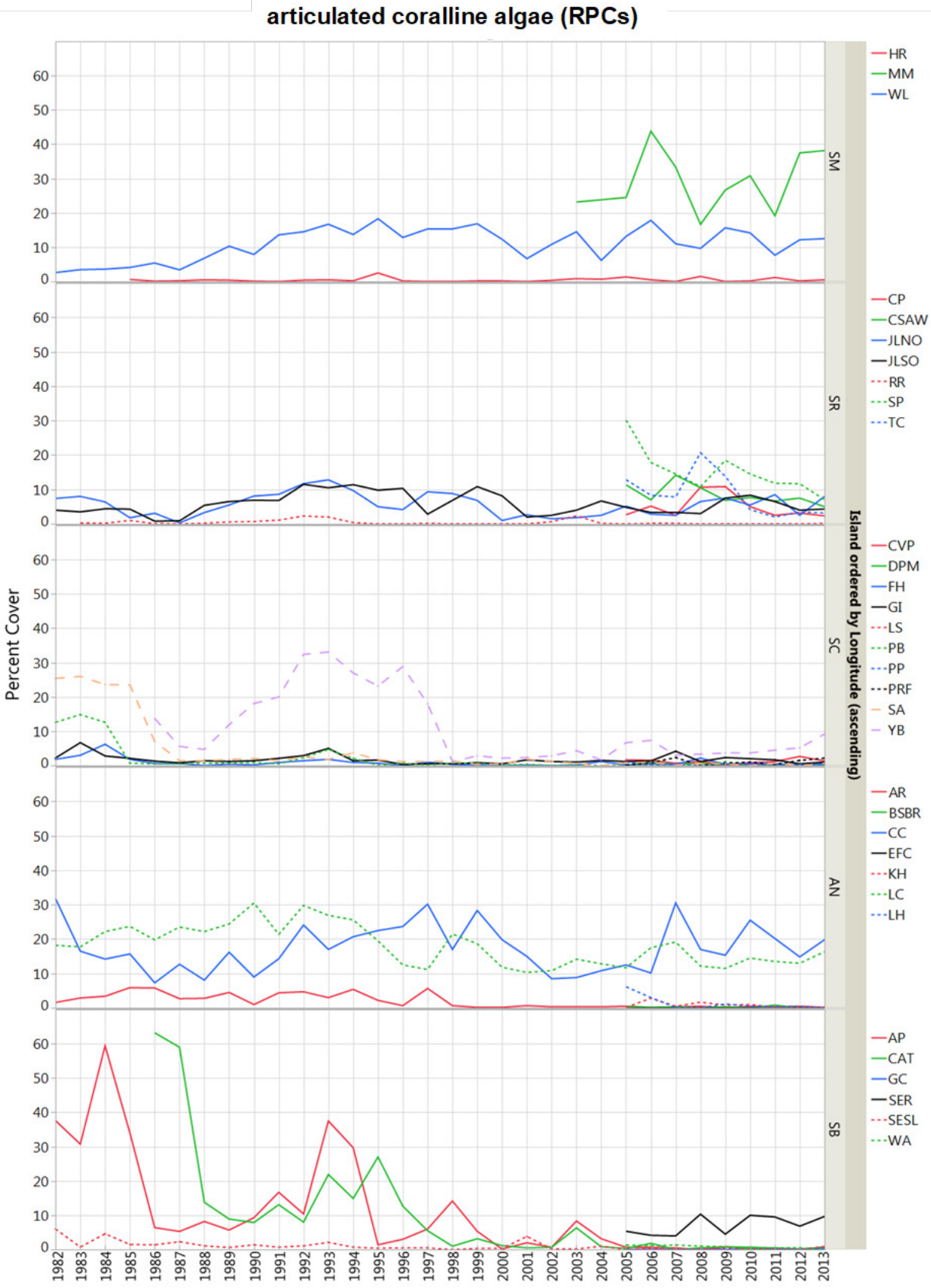

Desmarestia spp. (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
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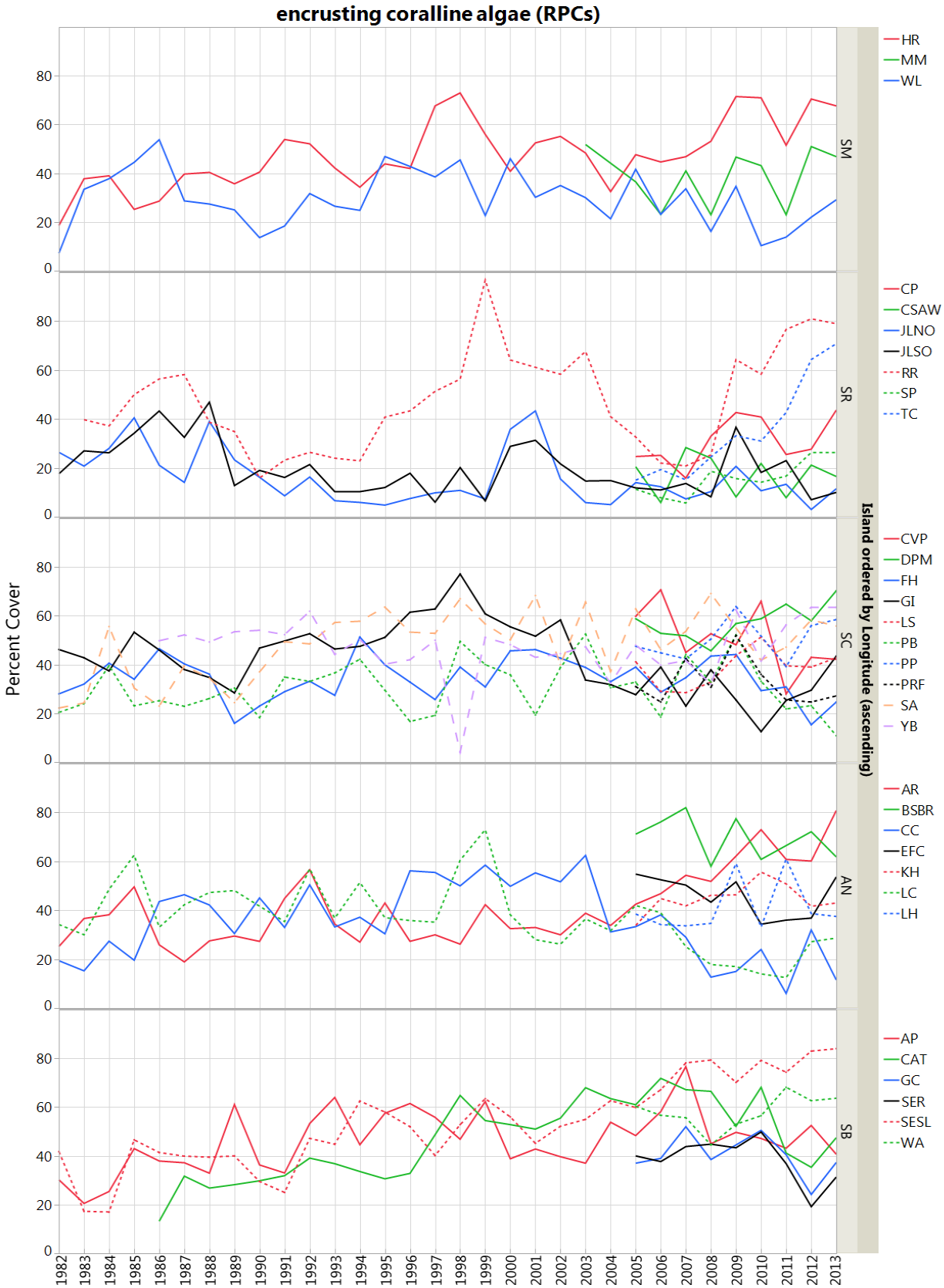

Brown algae, miscellaneous spp. (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
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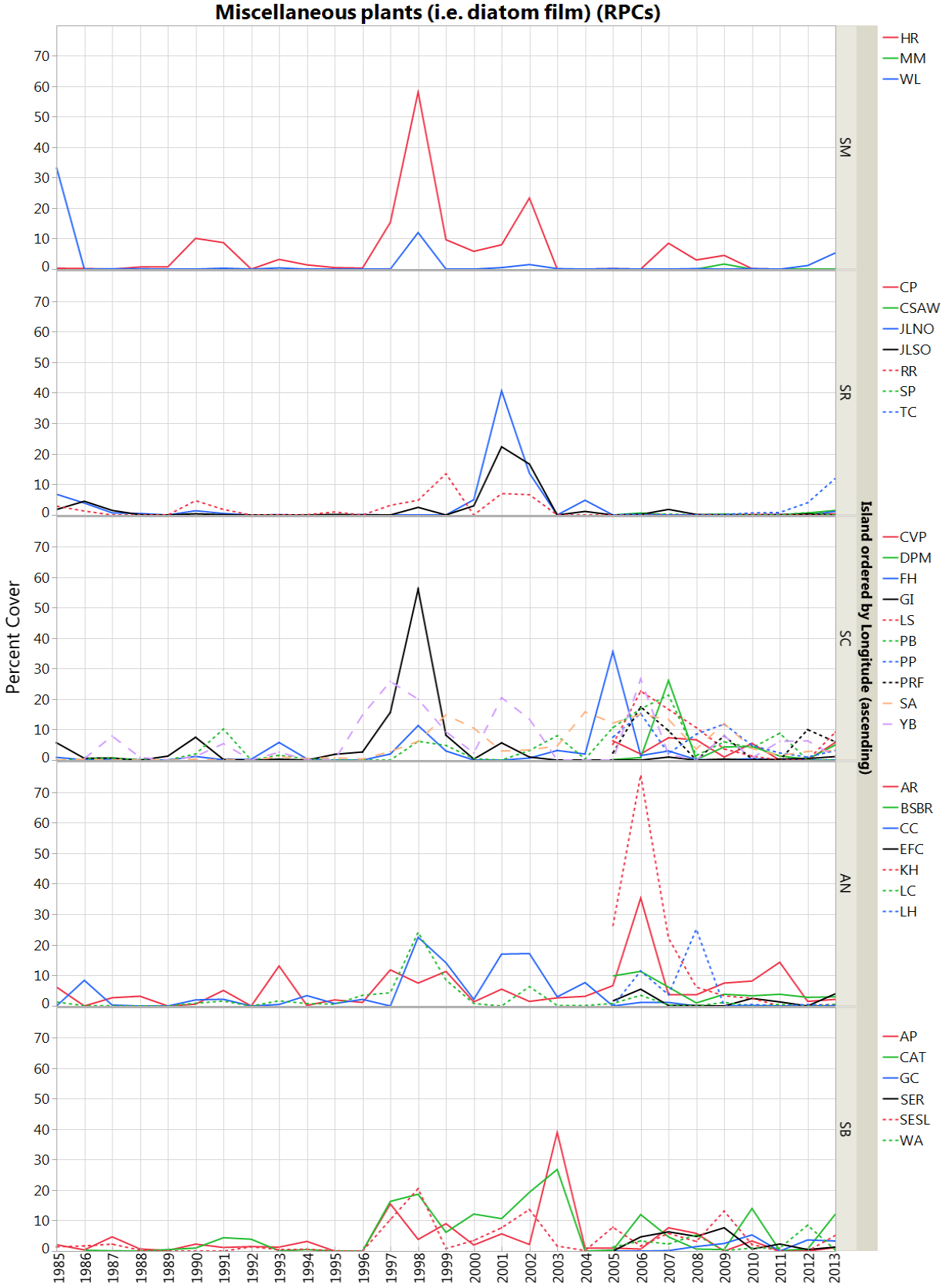

Gelidium spp. (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
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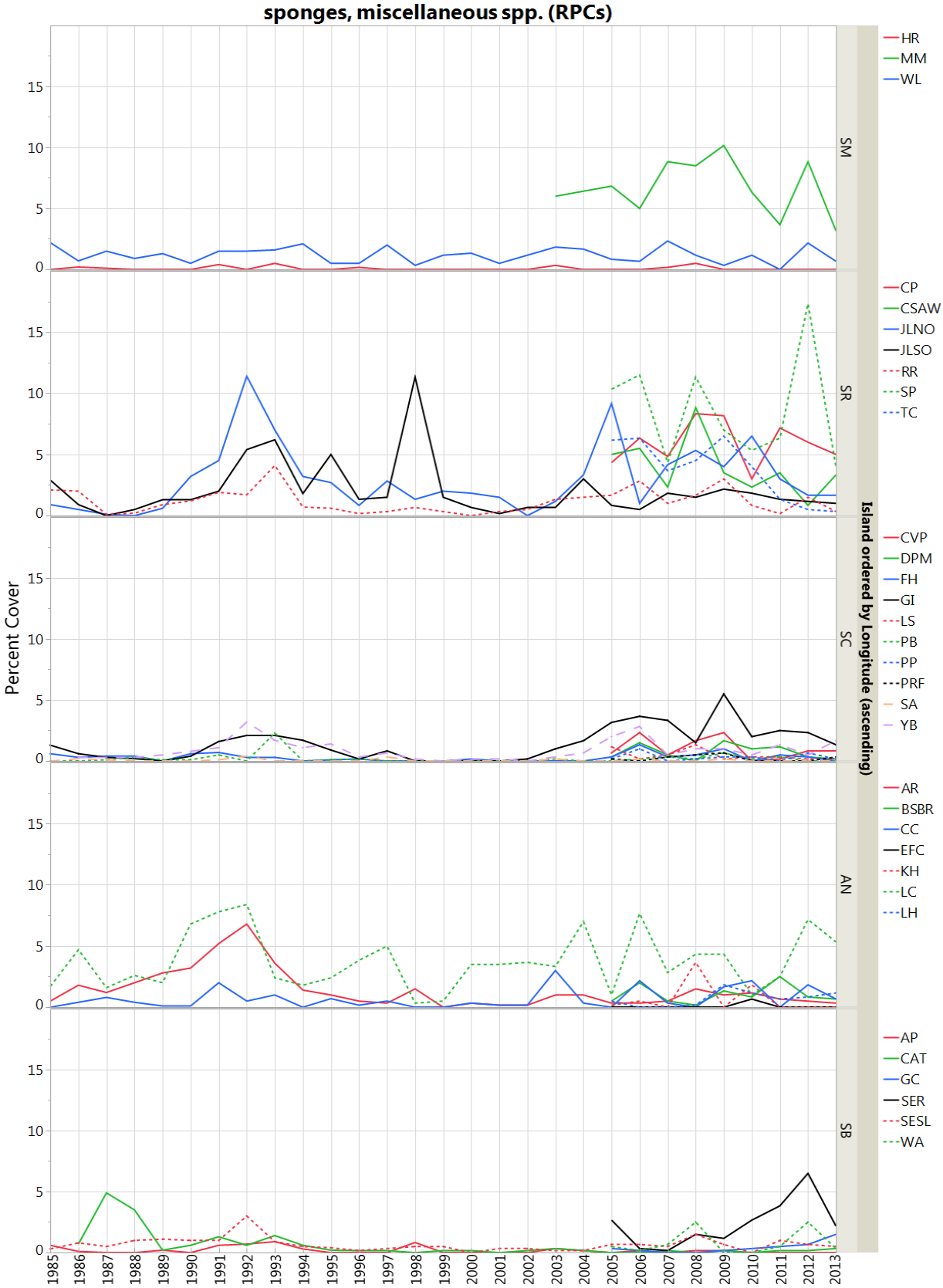

Gigartina spp. (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
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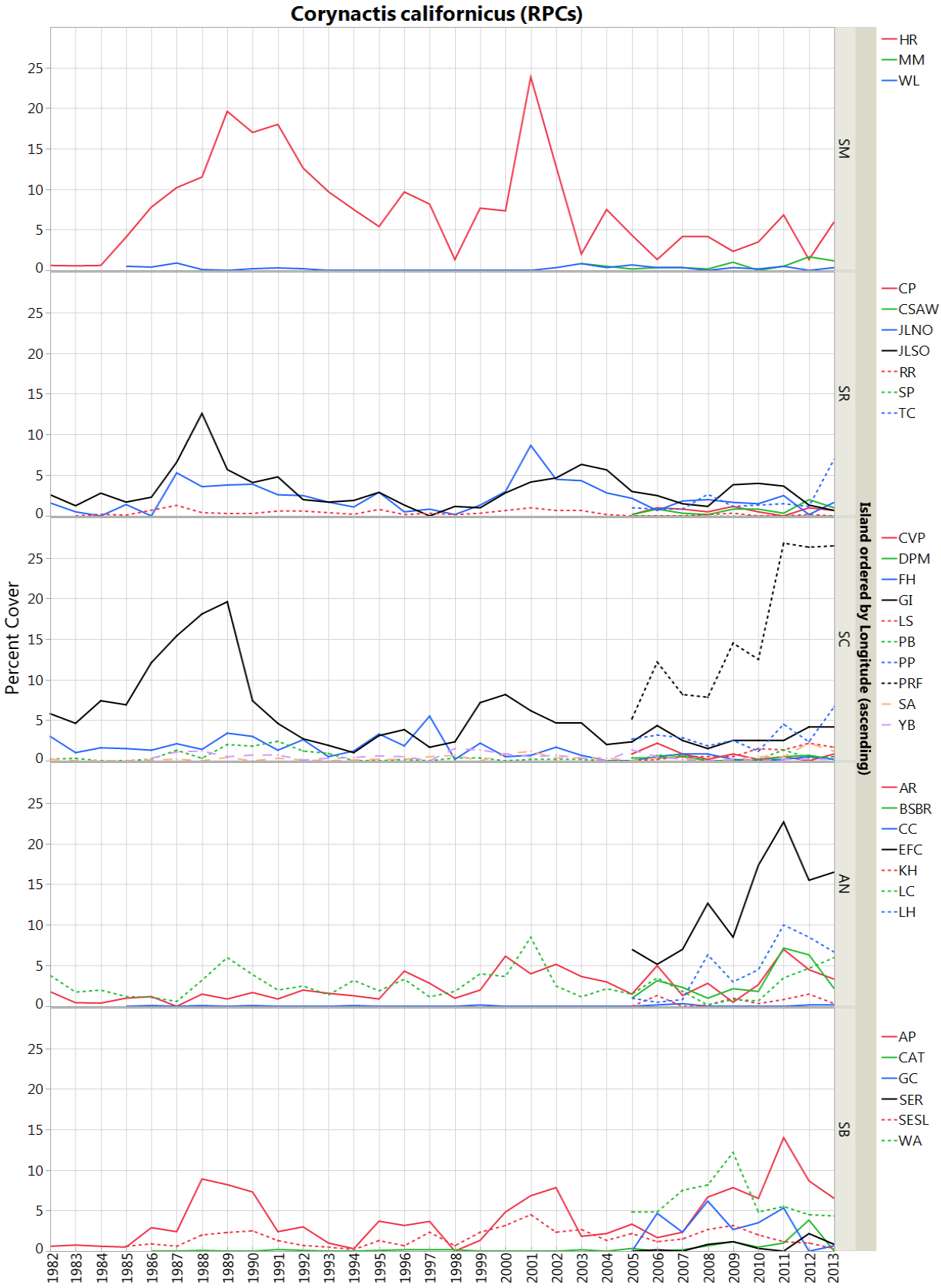

Red algae, miscellaneous spp. (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
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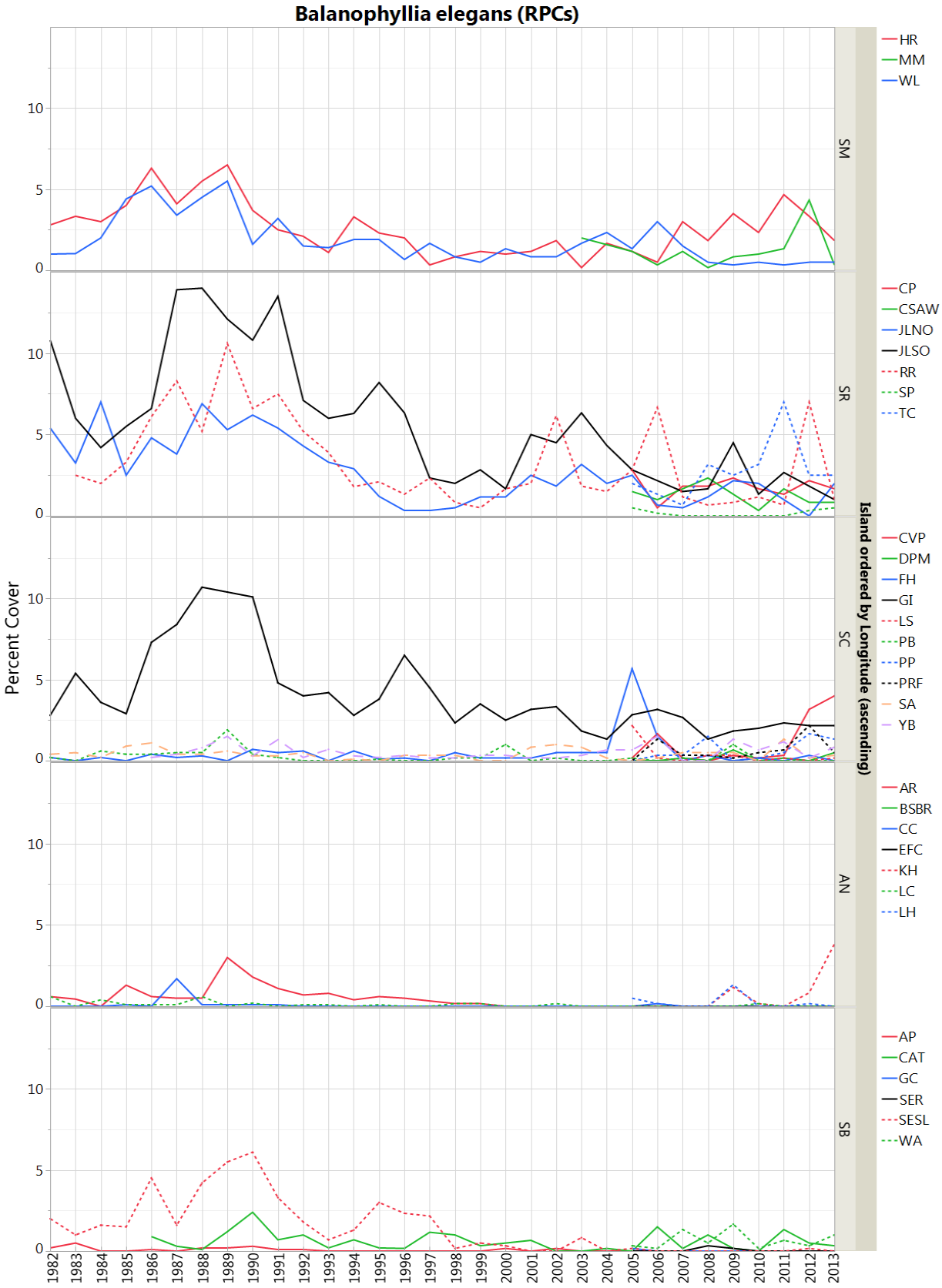

articulated coralline algae (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
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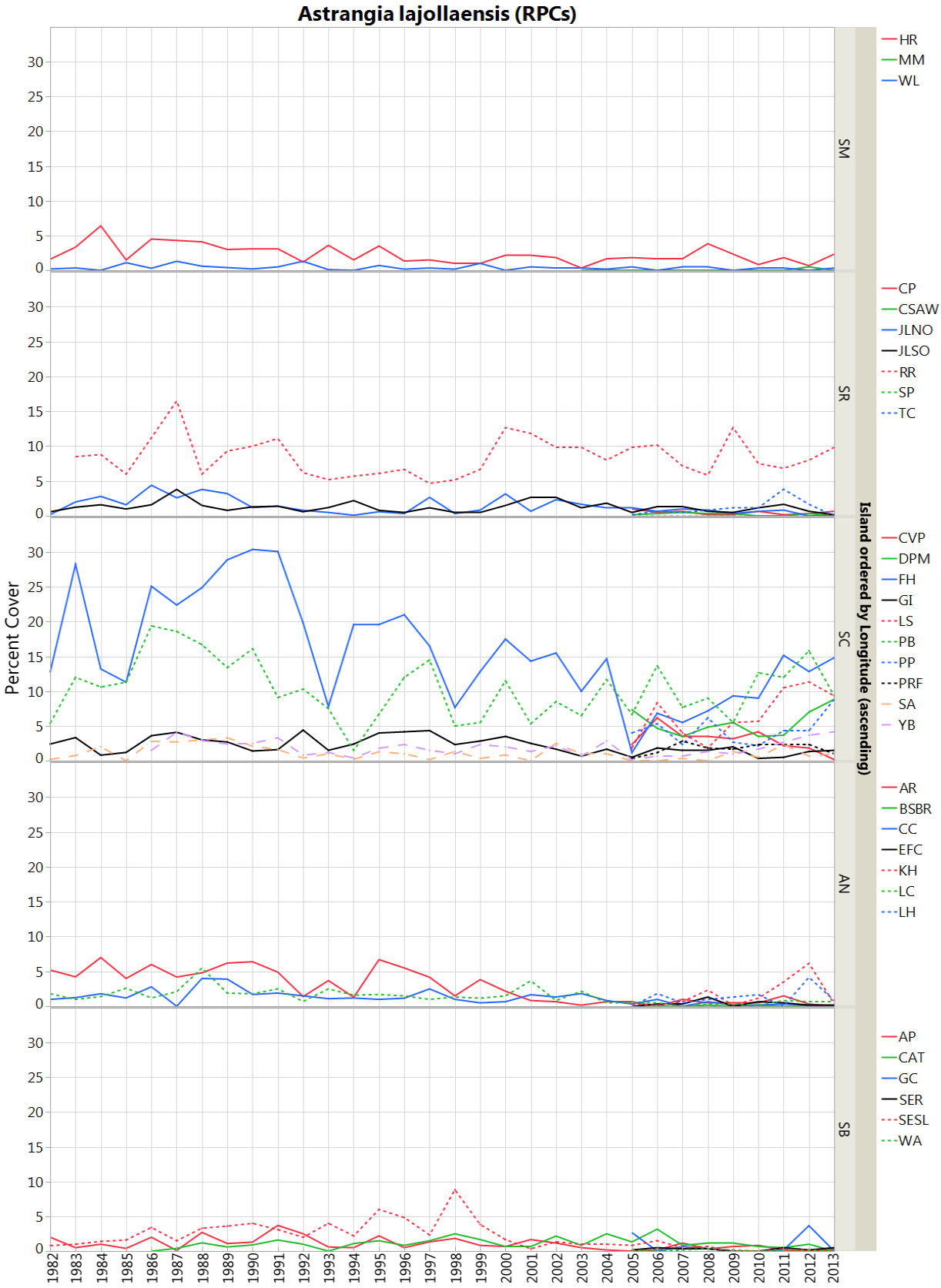

encrusting coralline algae (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
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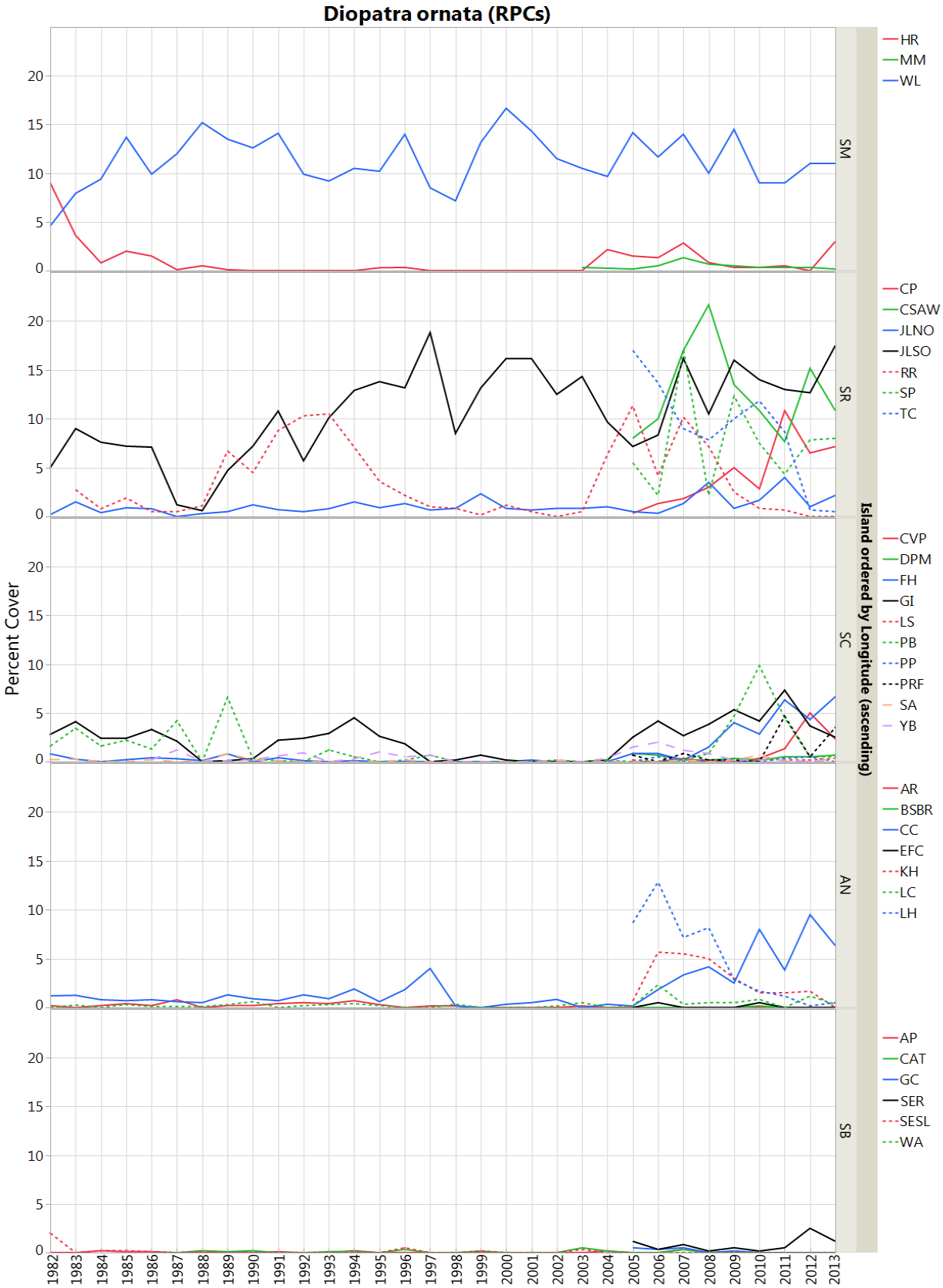

Miscellaneous plants (i.e. diatom film) (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
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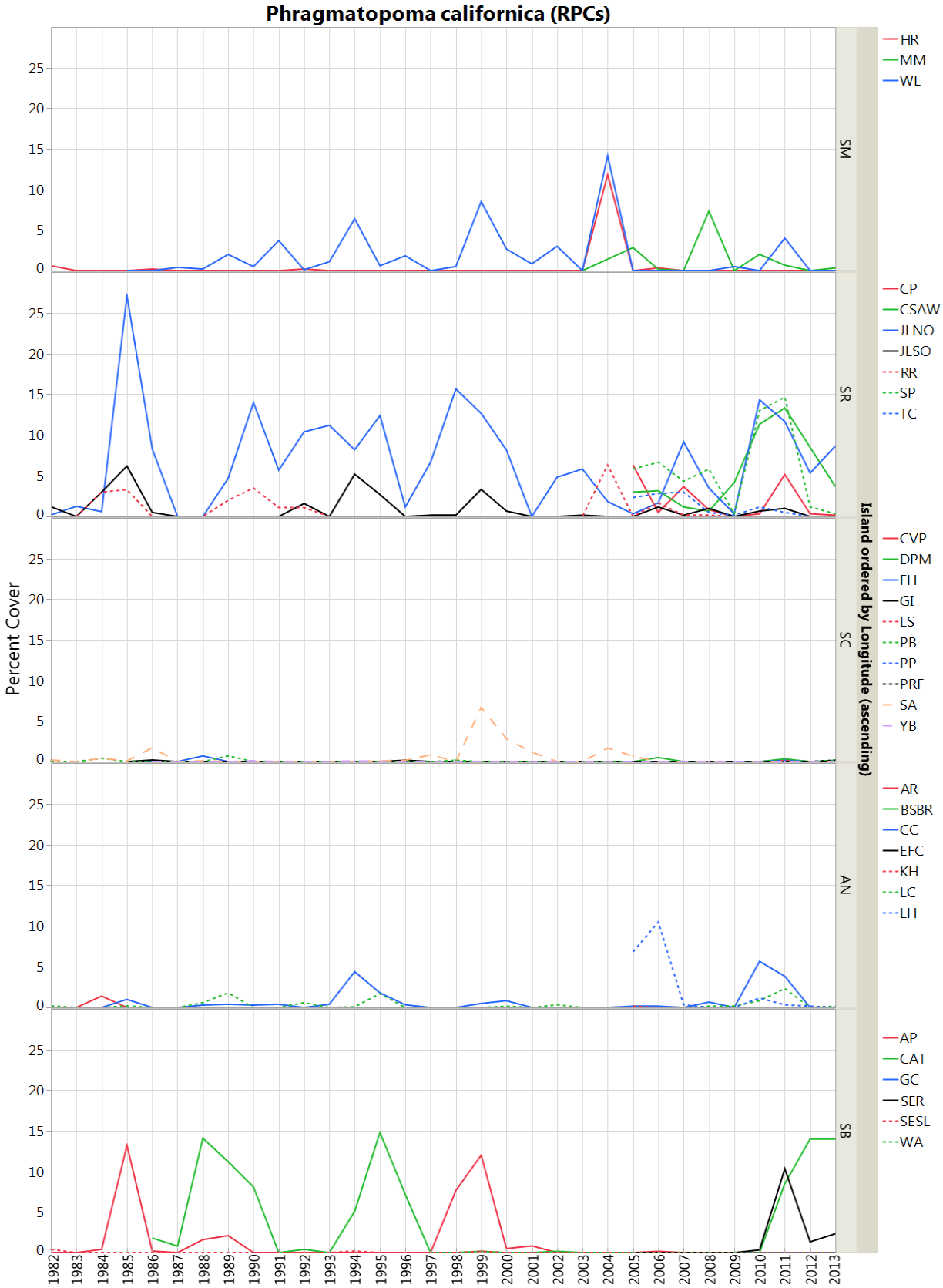

sponges, miscellaneous spp. (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
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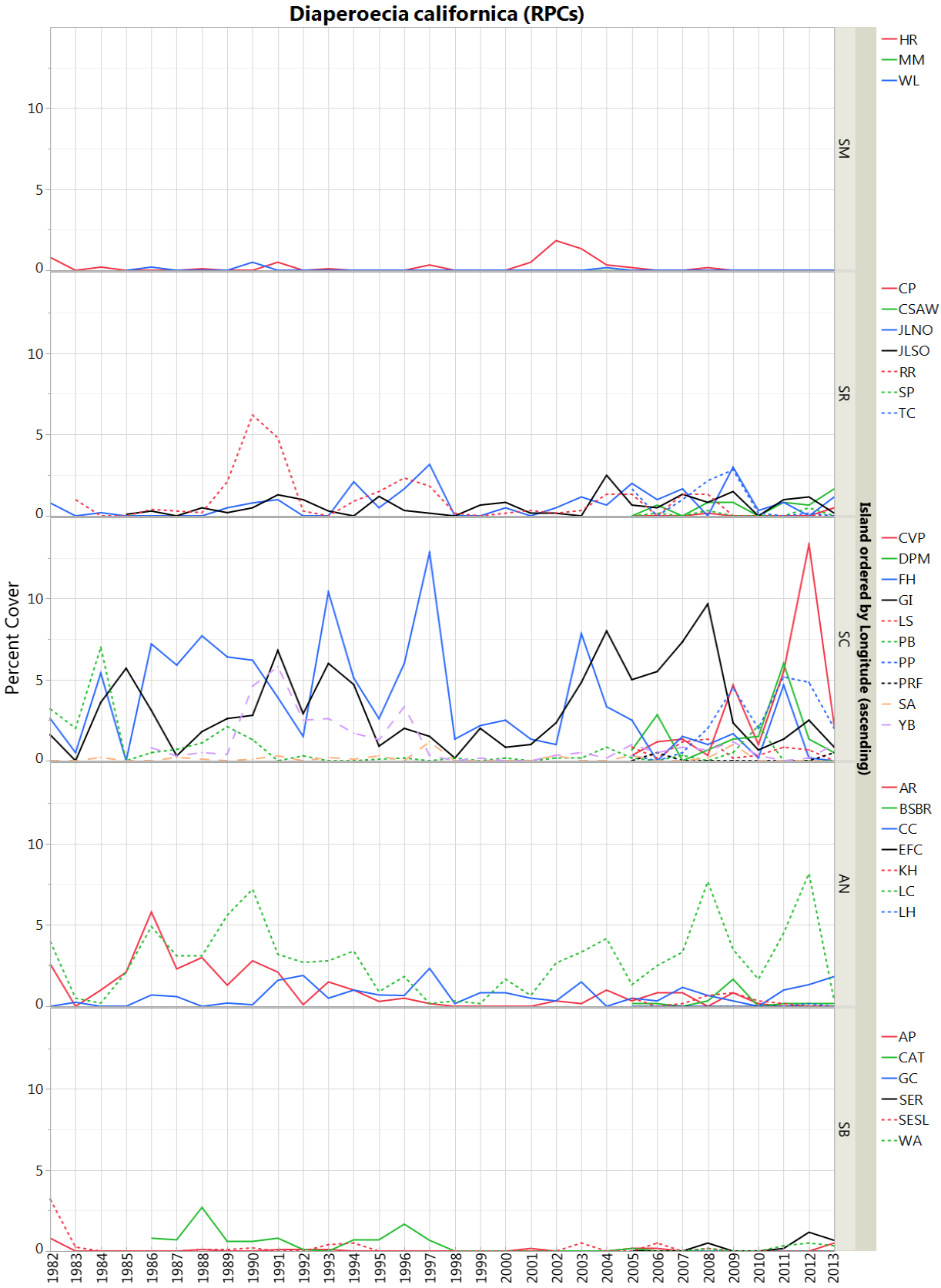

Corynactis californicus (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
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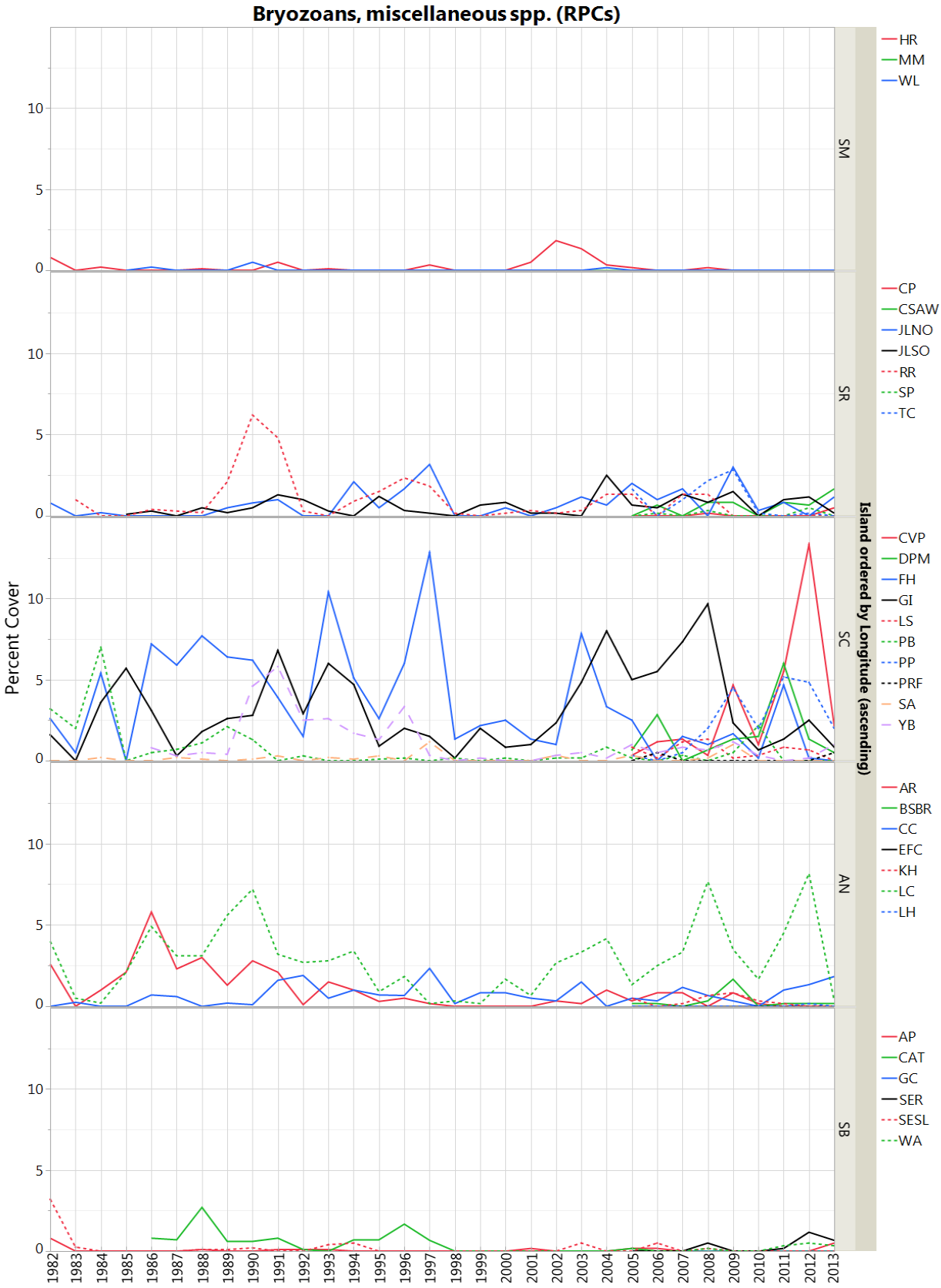

Balanophyllia elegans (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
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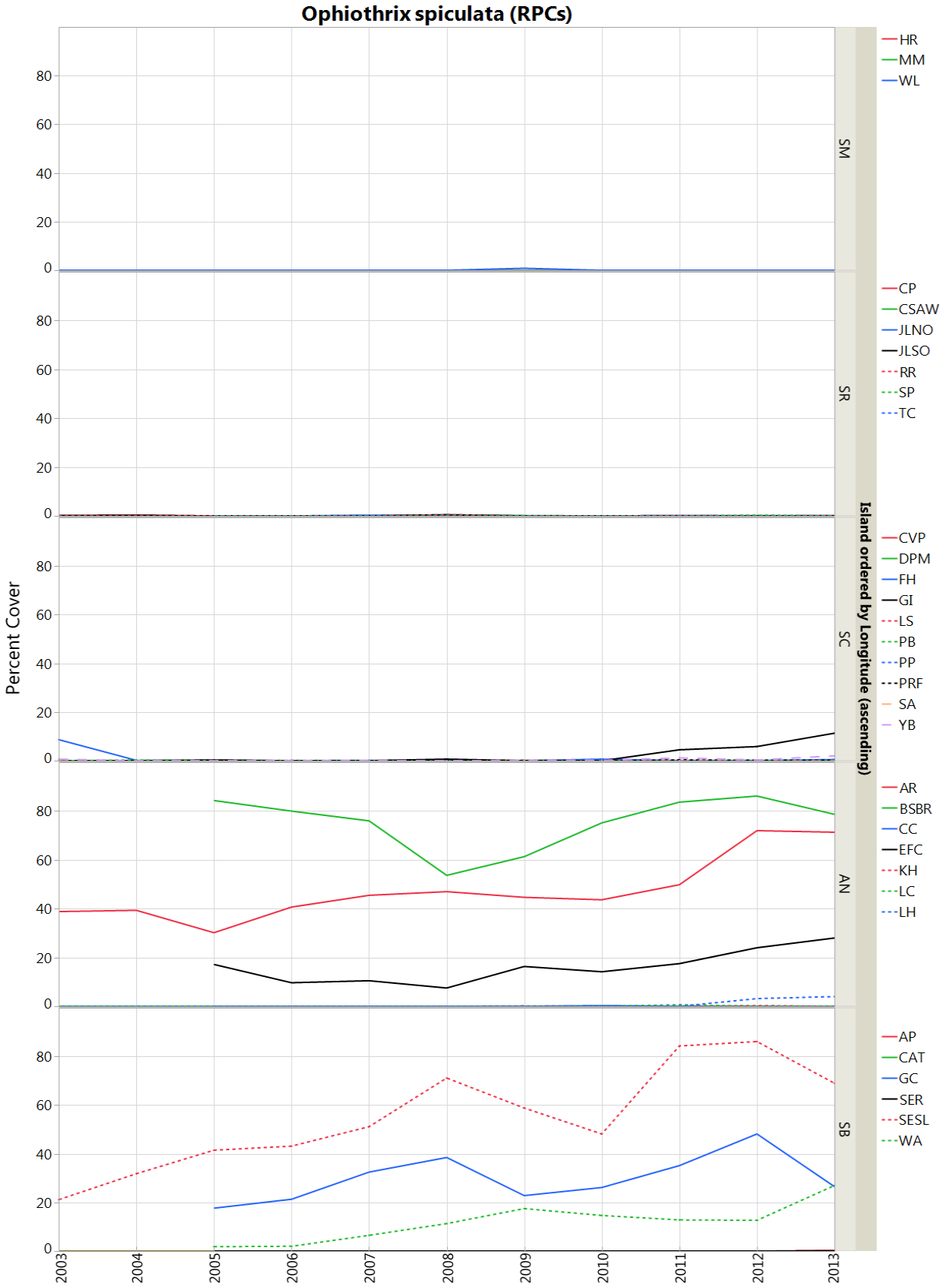

Astrangia lajollaensis (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
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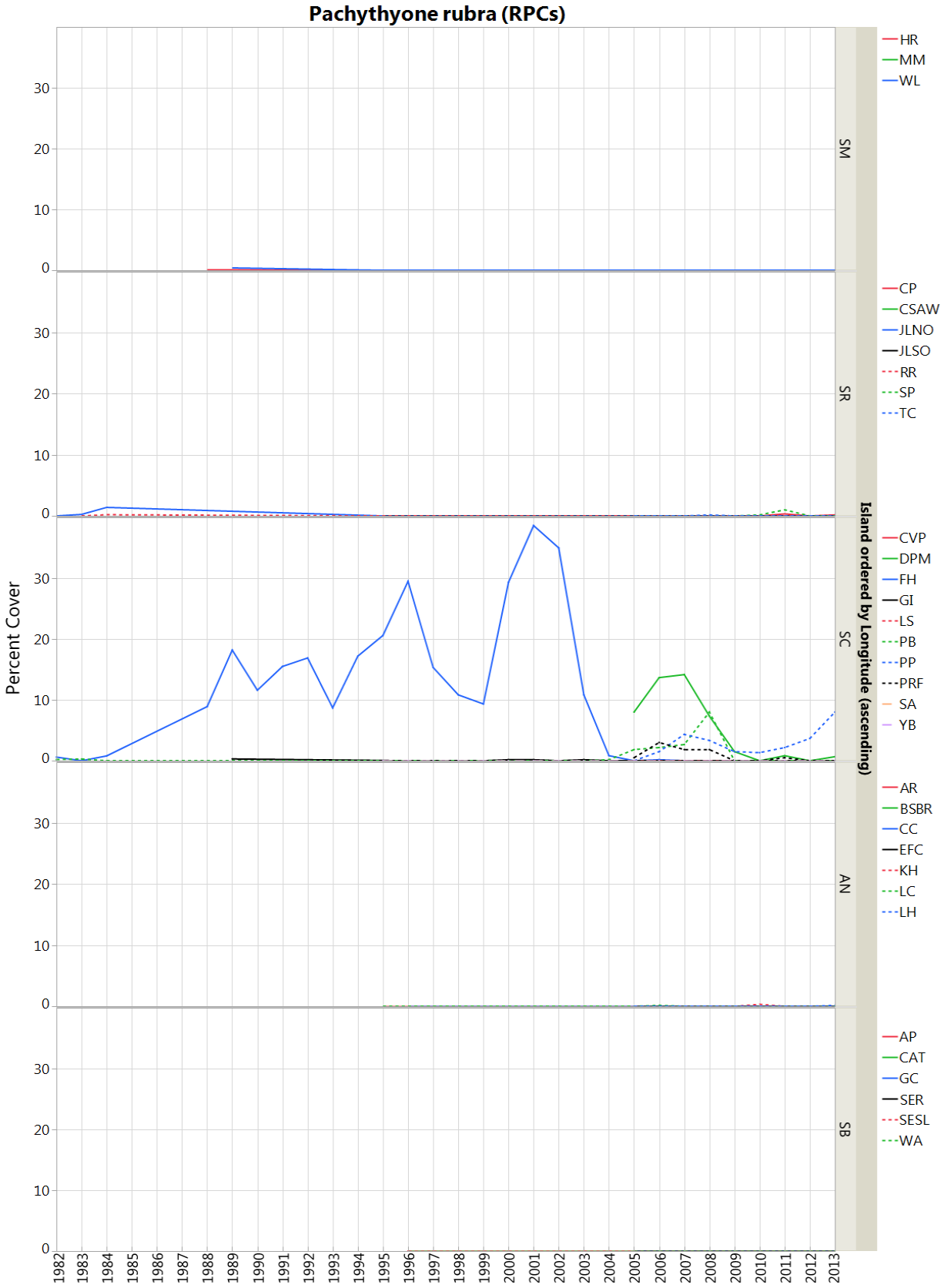

Diopatra ornata (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
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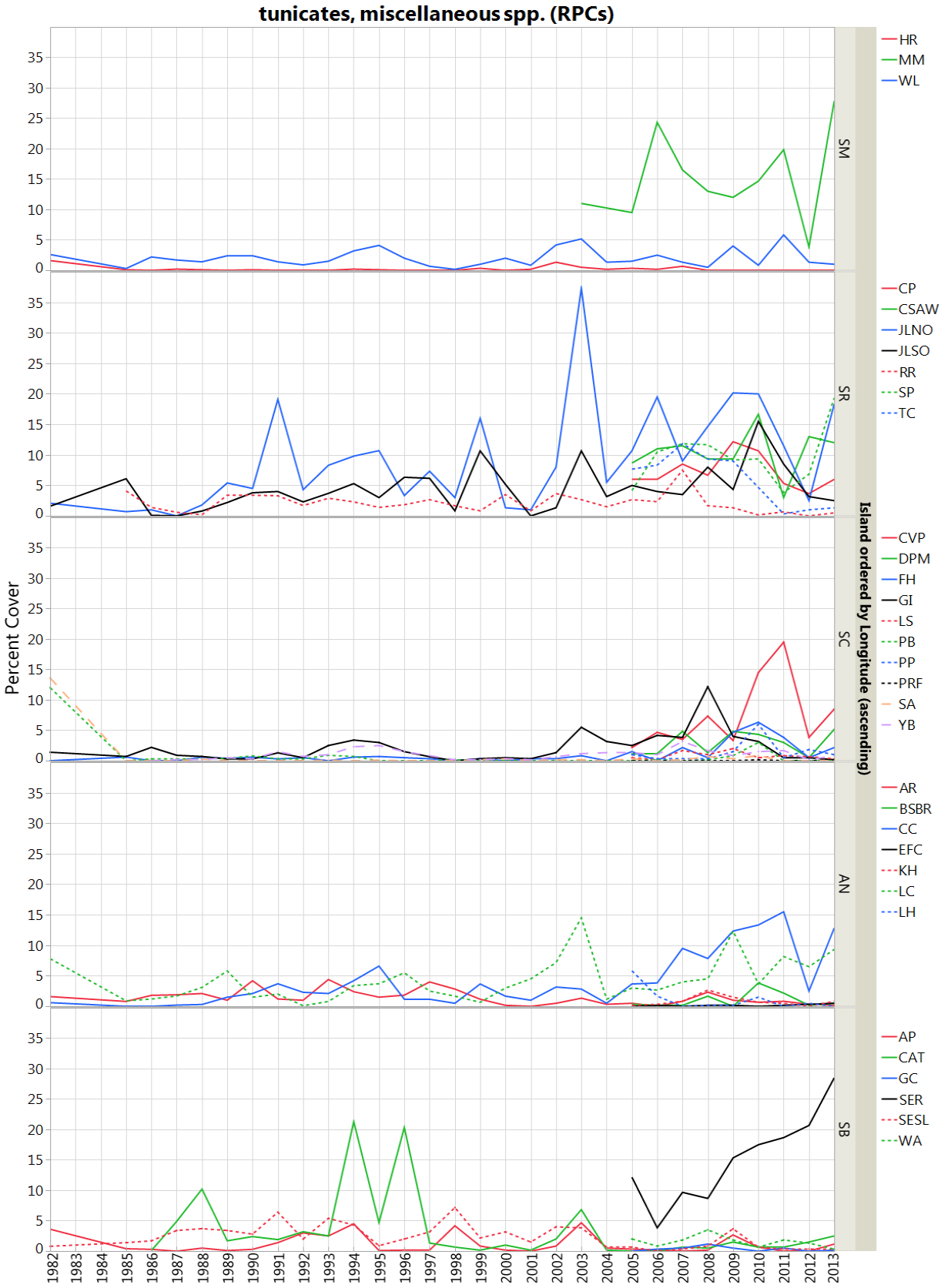

Phragmatopoma californica (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
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Diaperoecia californica (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
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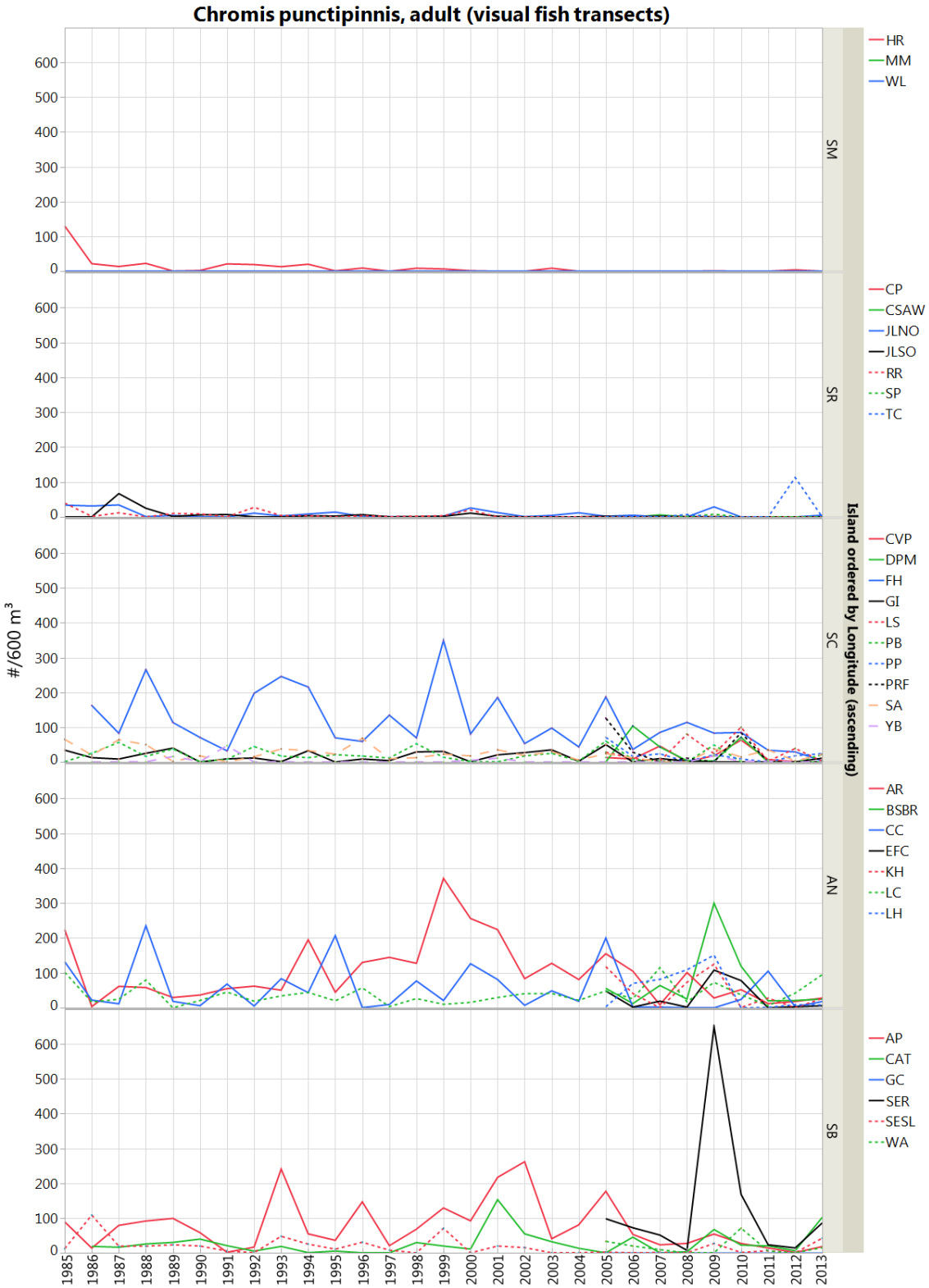

Bryozoans, miscellaneous spp. (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
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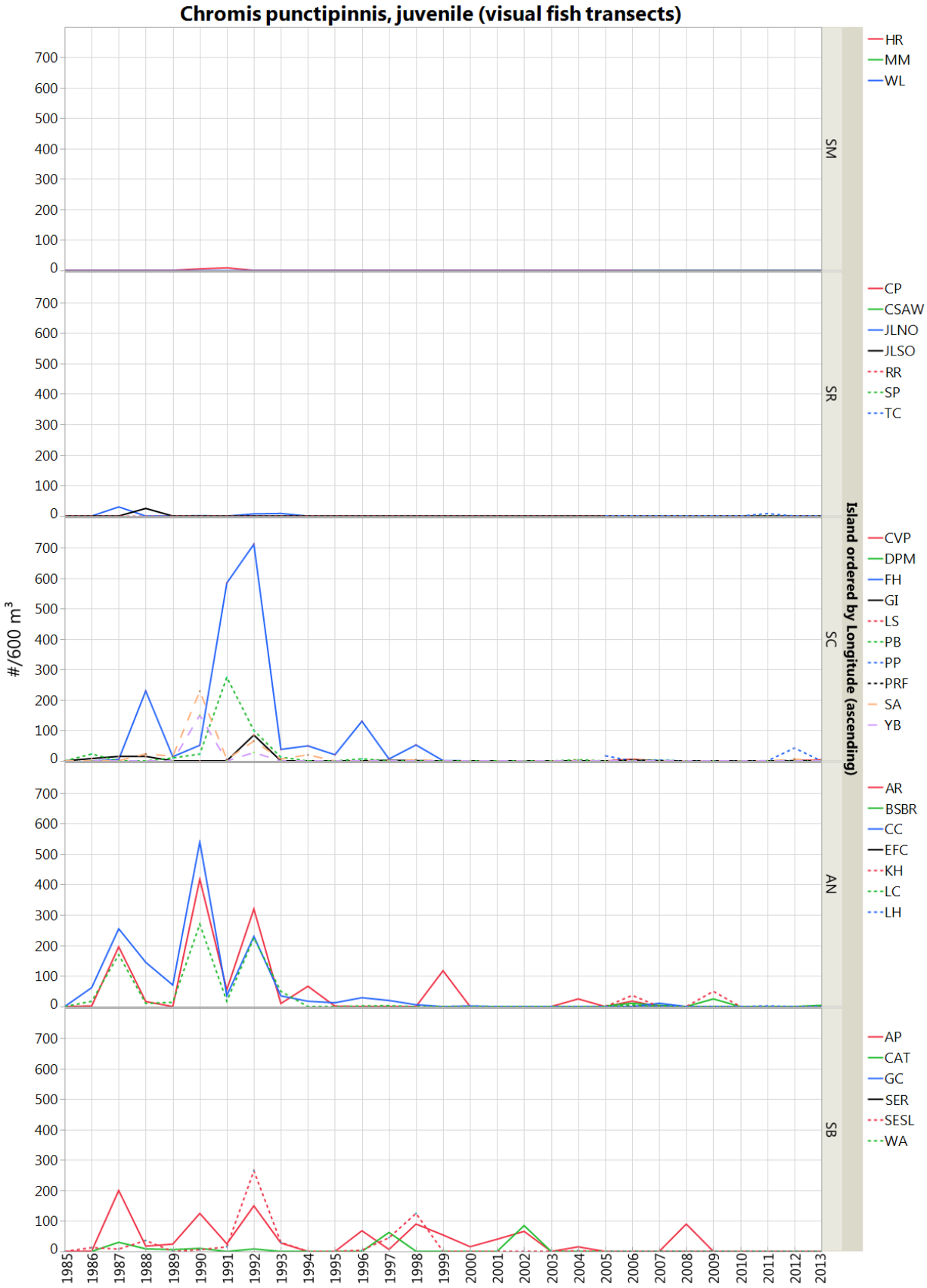

Ophiothrix spiculata (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
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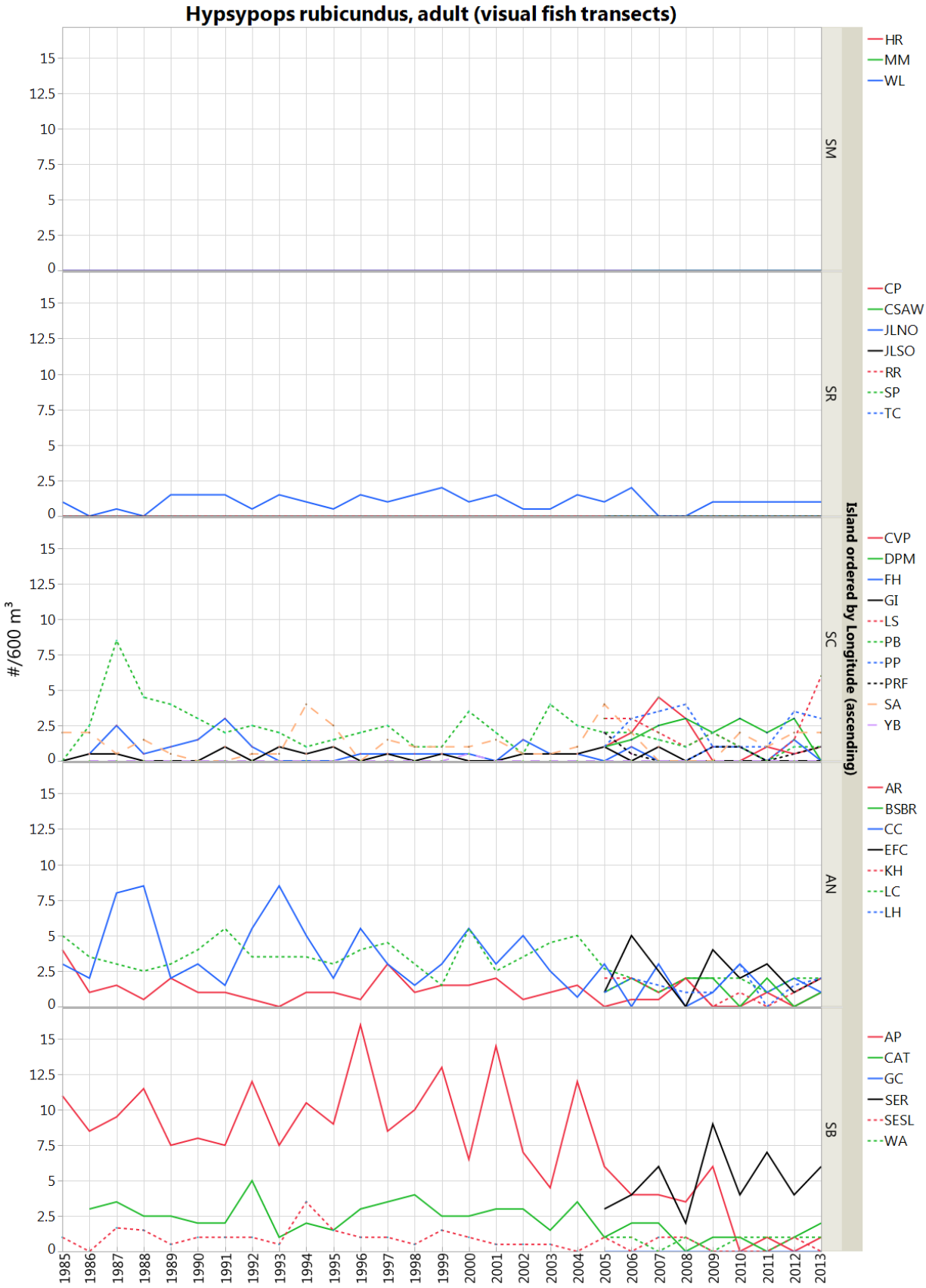

Pachythyone rubra (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
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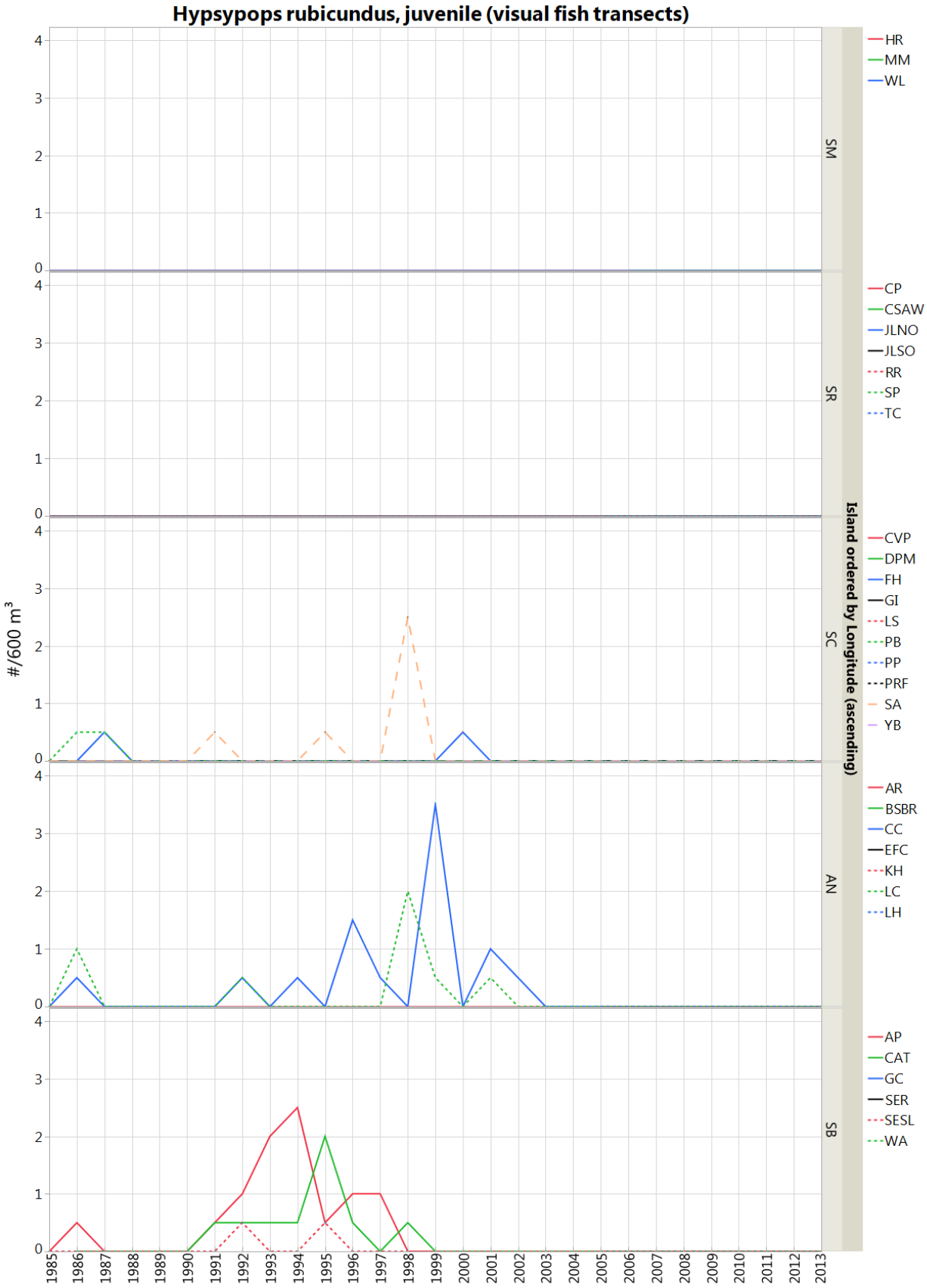

tunicates, miscellaneous spp. (RPCs)
Percent Cover
Island ordered by Longitude (ascending)
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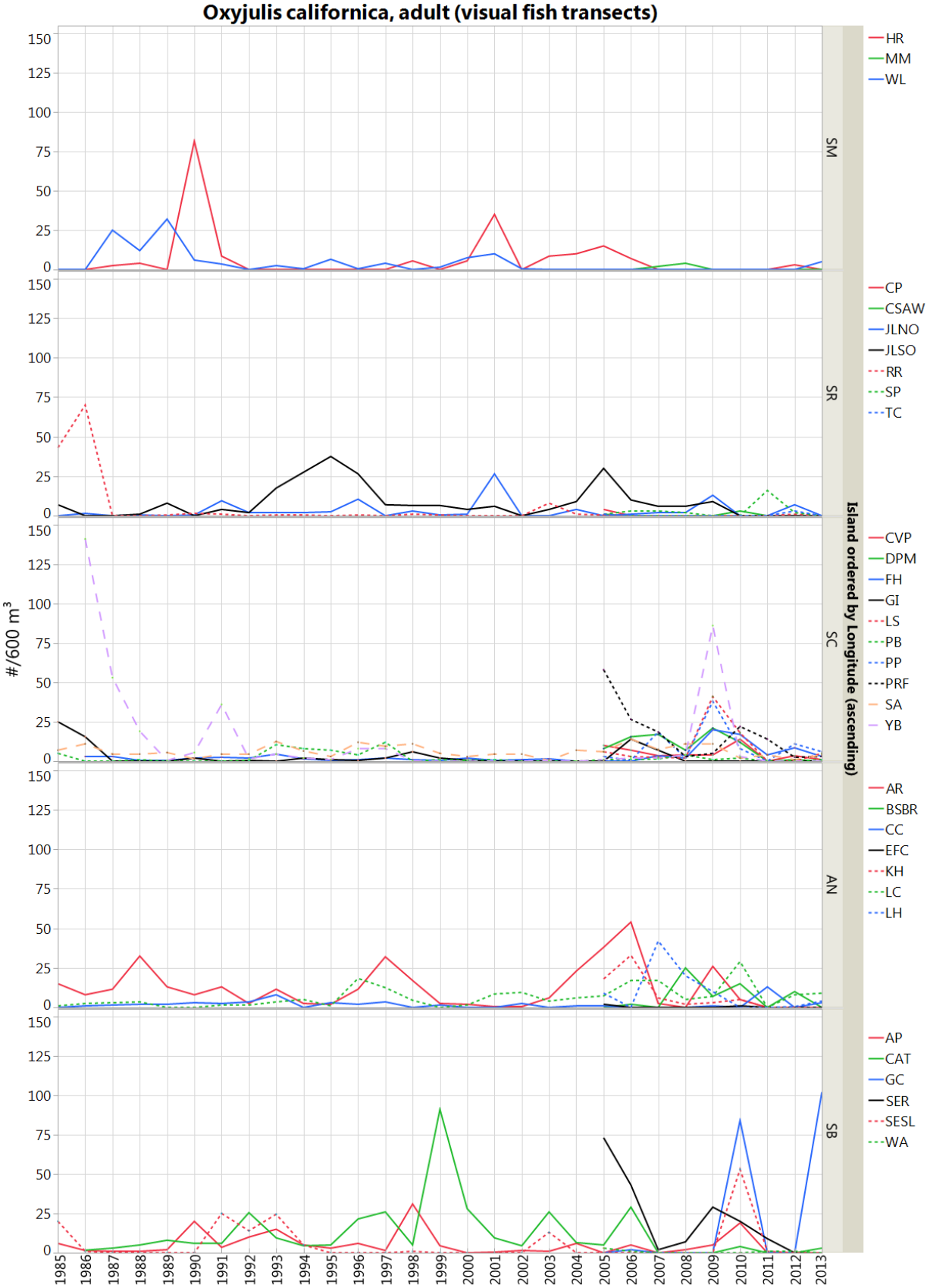
Appendix I. Fish Transect Data

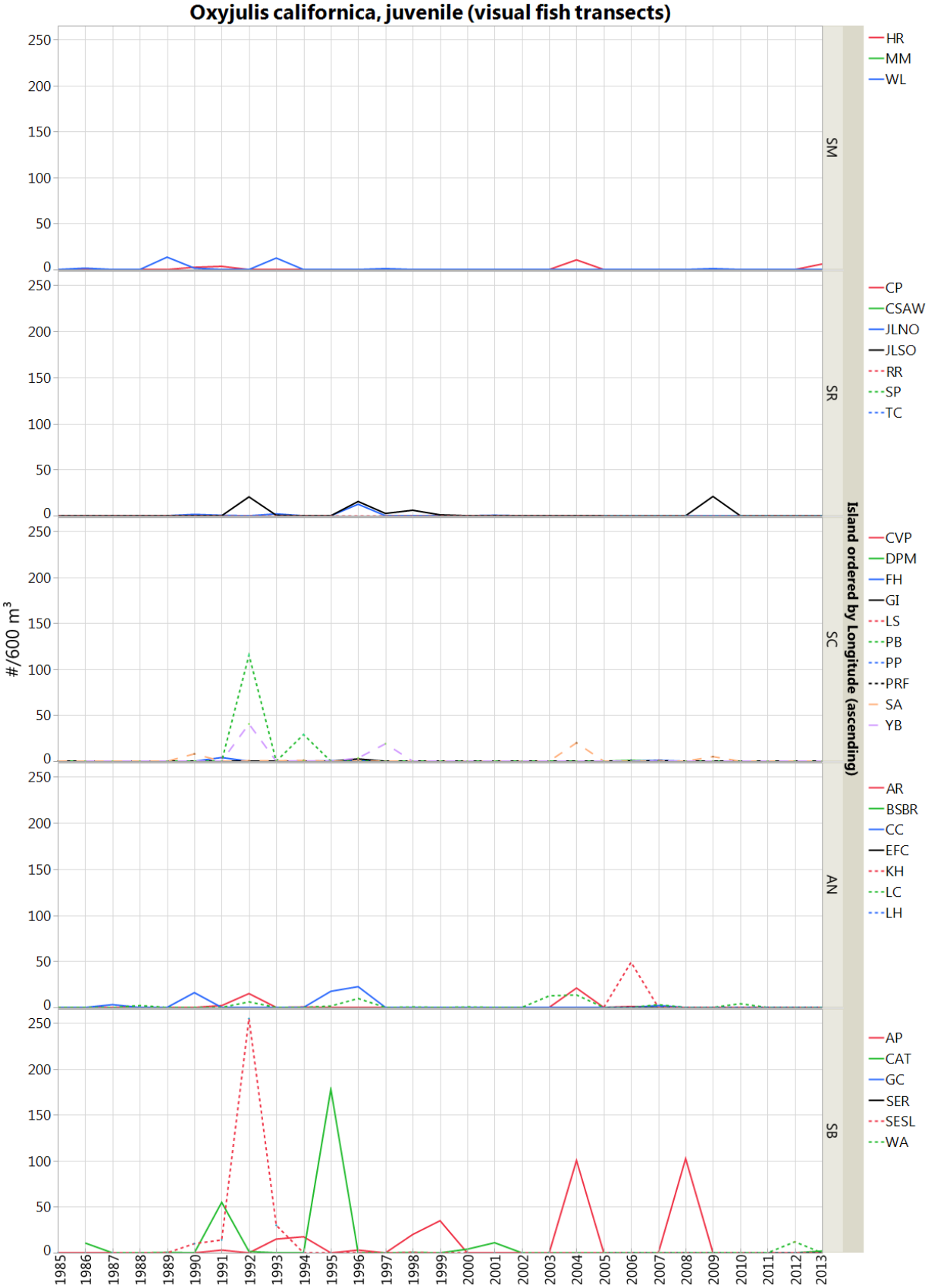


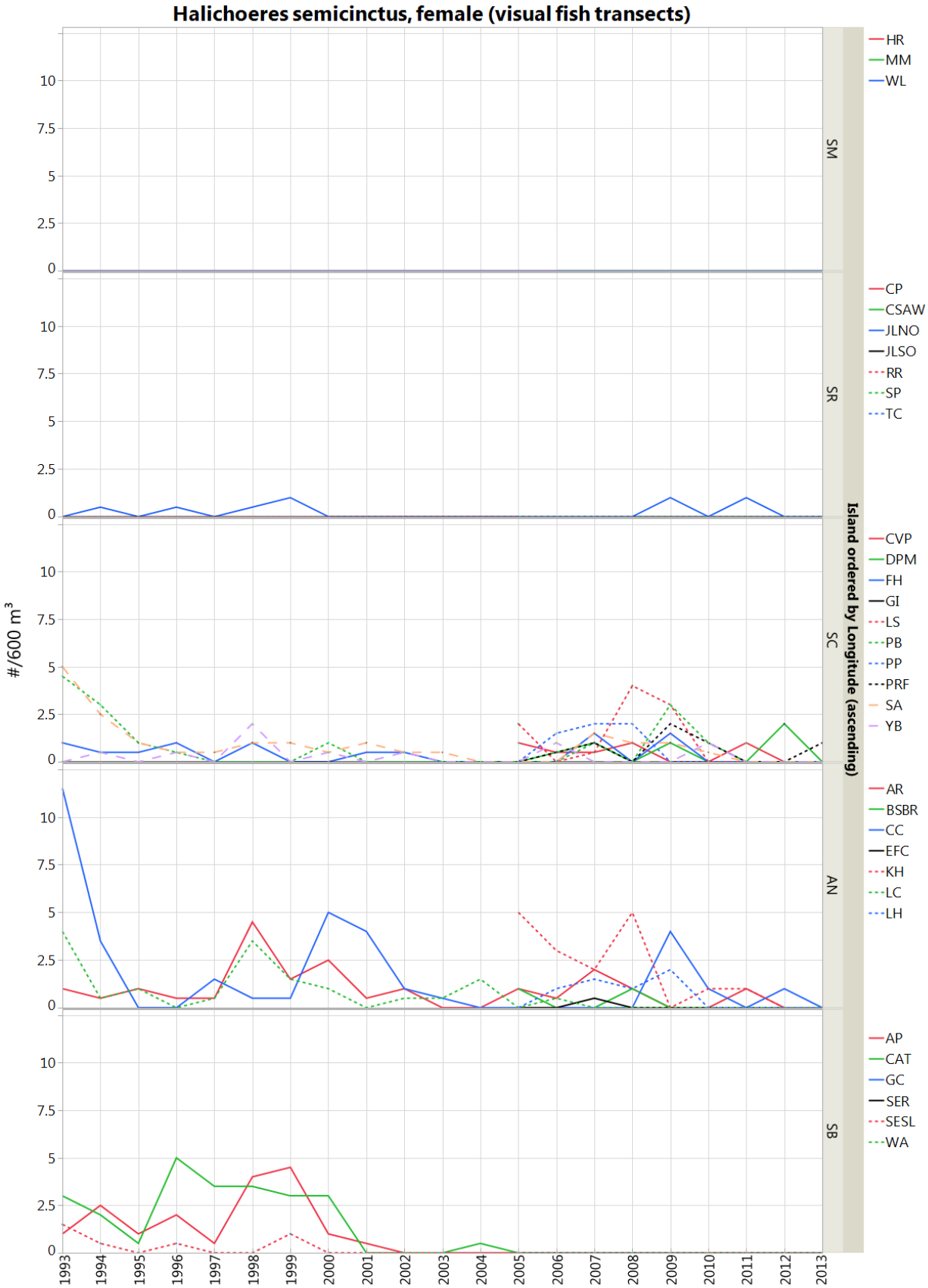

Chromis punctipinnis, juvenile (visual fish transects)
#/600 m³
Island ordered by Longitude (ascending)
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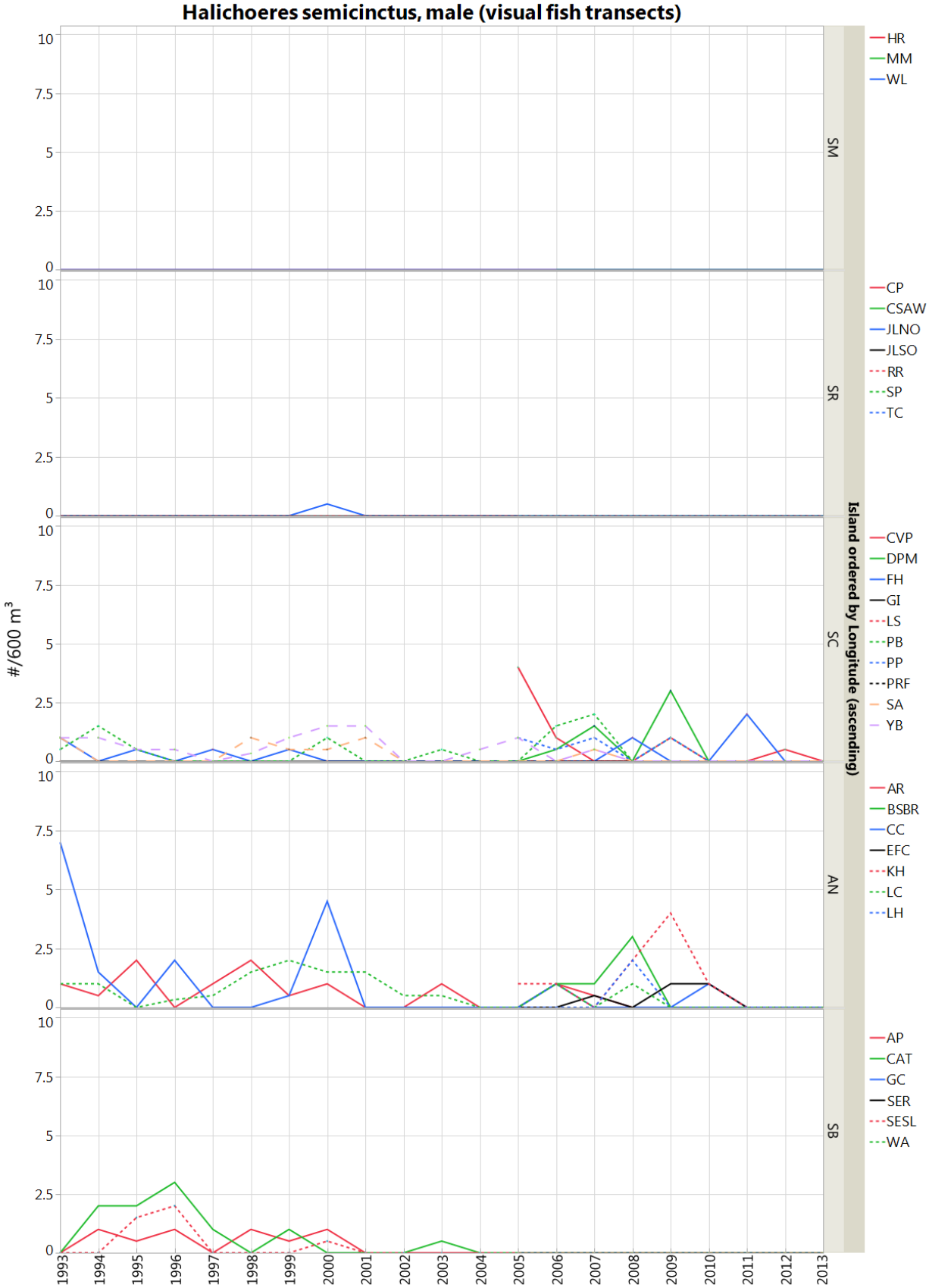

Hypsypops rubicundus, adult (visual fish transects)
#/600 m³
Island ordered by Longitude (ascending)
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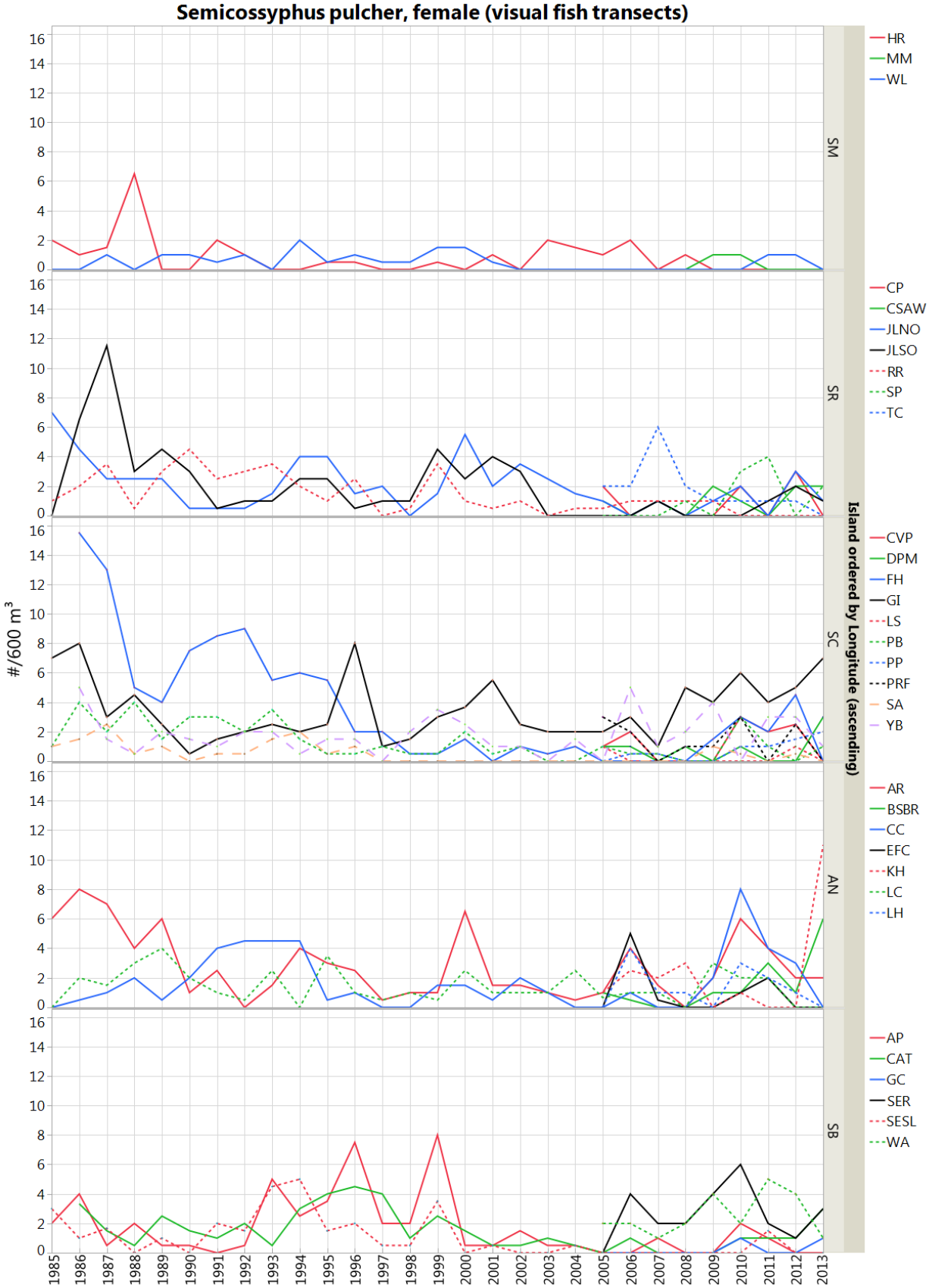

Hypsypops rubicundus, juvenile (visual fish transects)
#/600 m³
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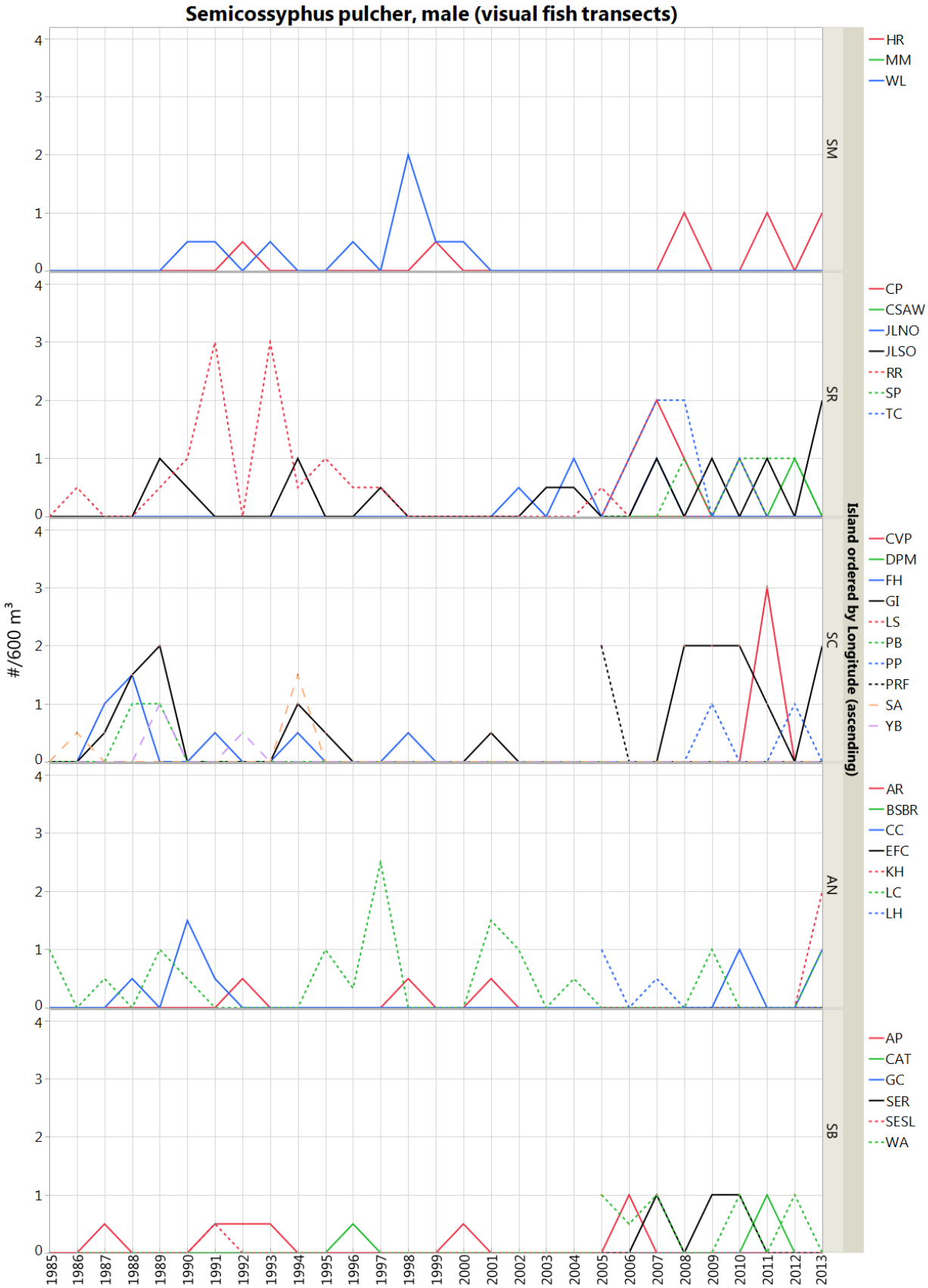

Oxyjulis californica, adult (visual fish transects)
#/600 m³
Island ordered by Longitude (ascending)
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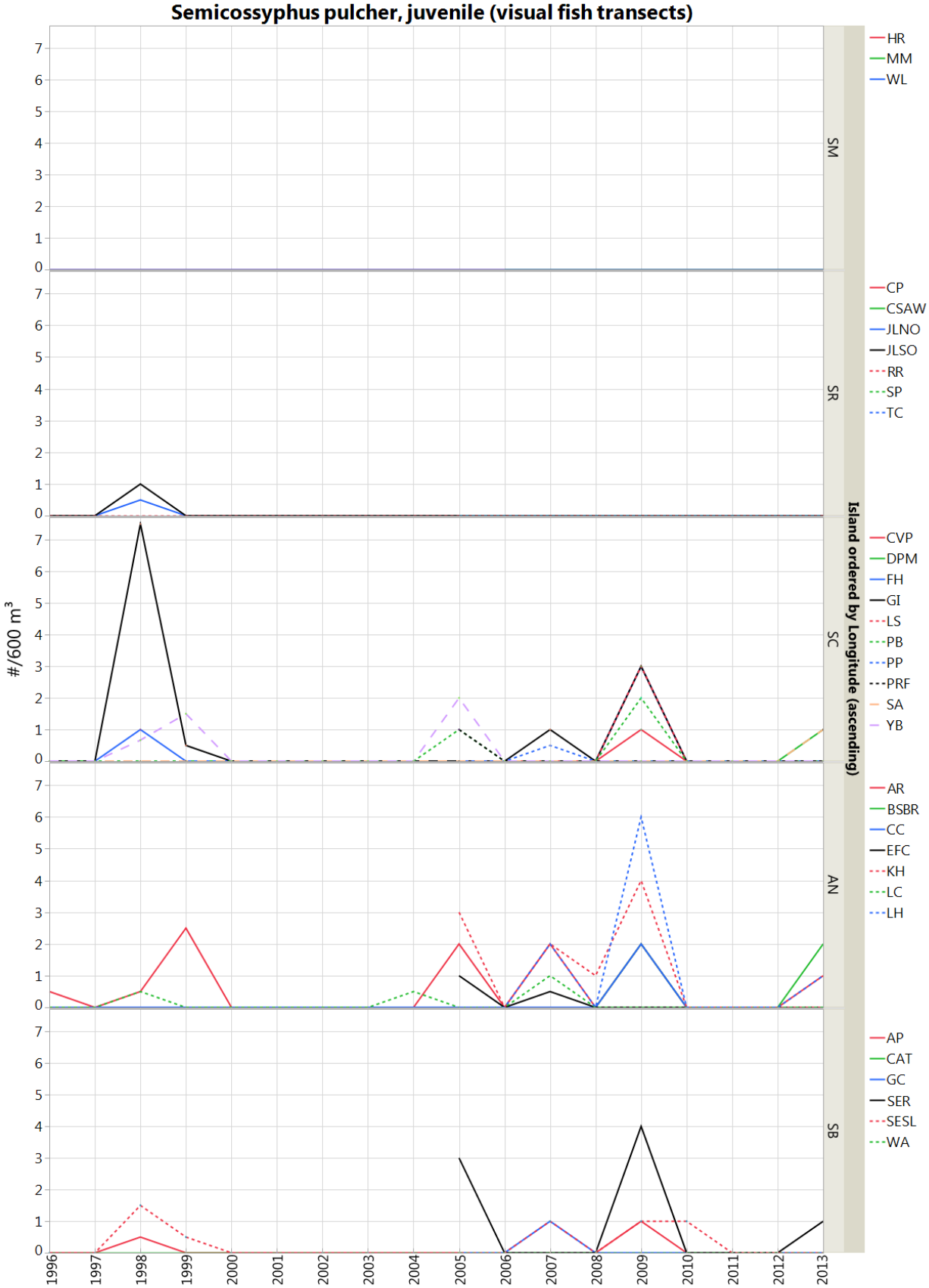

Oxyjulis californica, juvenile (visual fish transcripts)
#/600 m³
Island ordered by Longitude (ascending)
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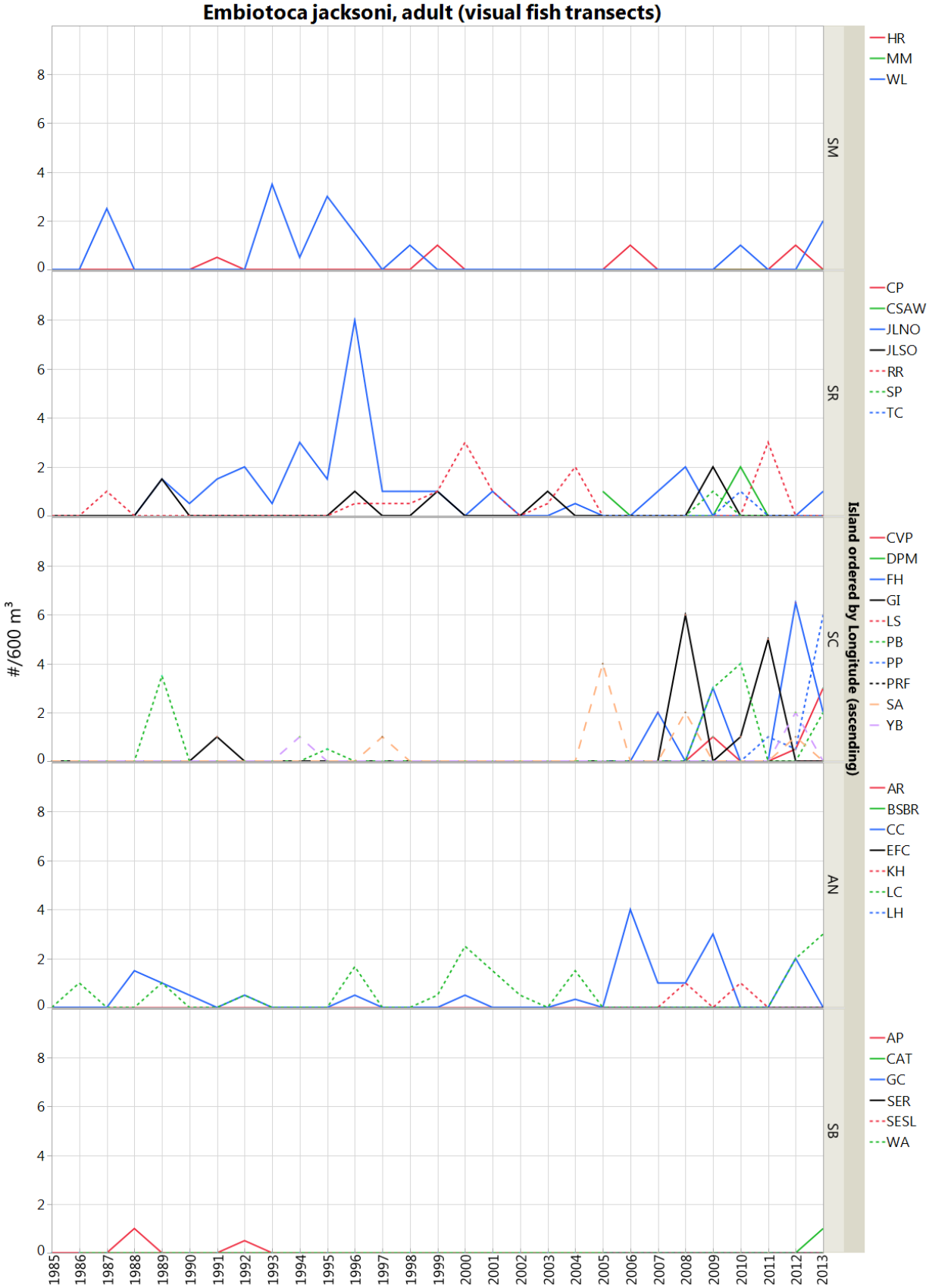

Halichoeres semicinctus, female (visual fish transects)
#/600 m³
Island ordered by Longitude (ascending)
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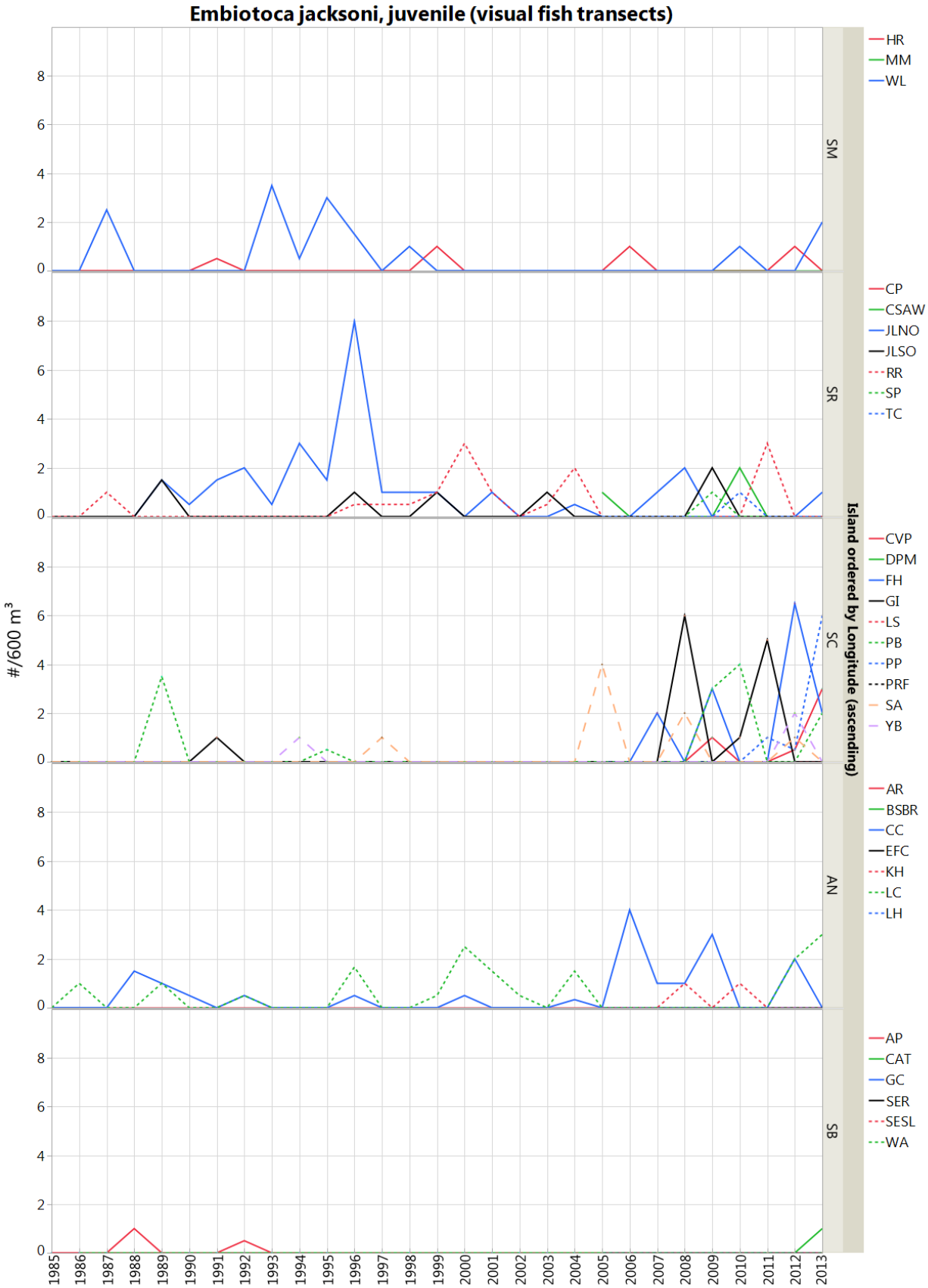

Halichoeres semicinctus, male (visual fish transects)
#/600 m³
Island ordered by Longitude (ascending)
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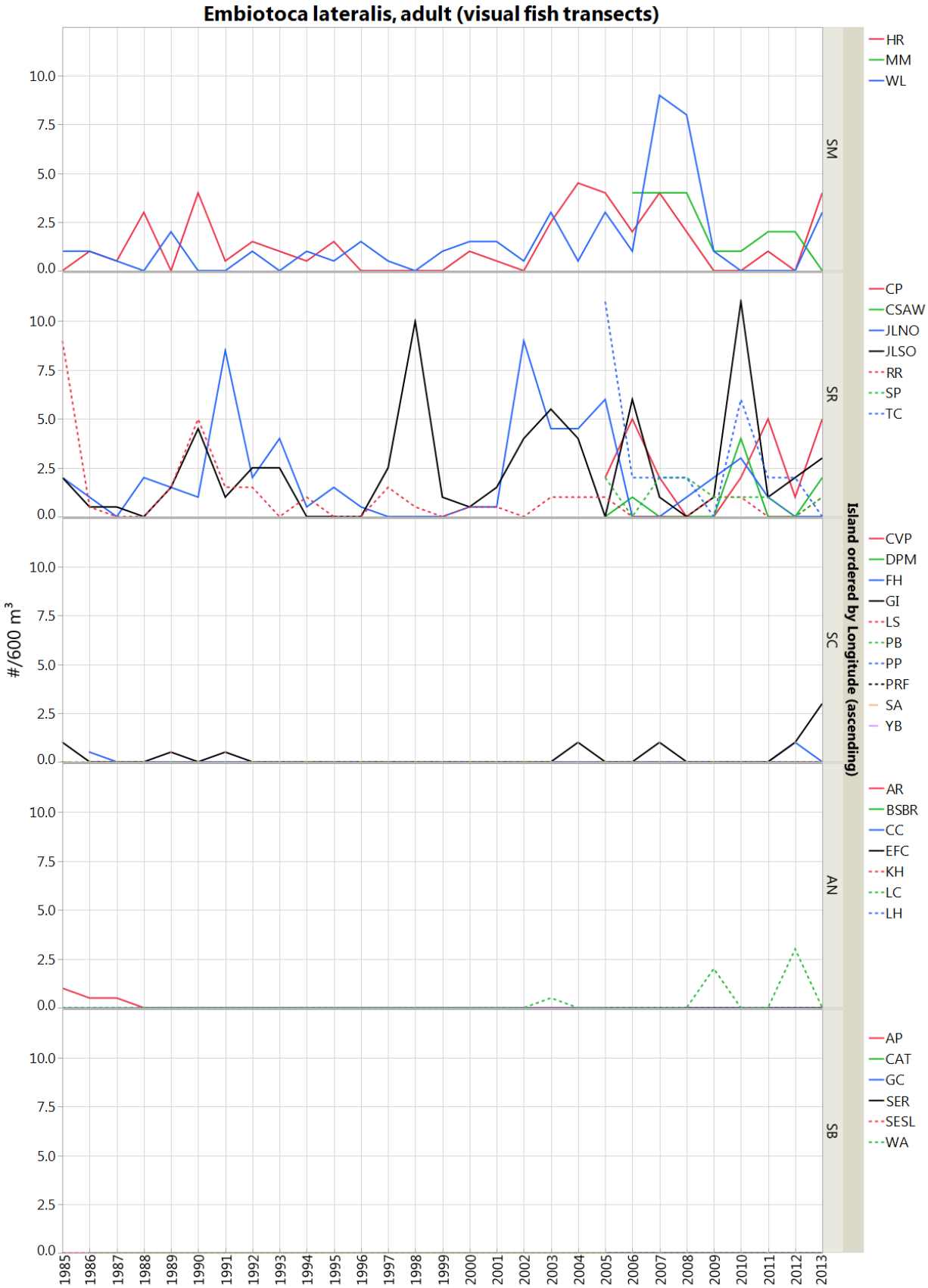

Semicossyphus pulcher, female (visual fish transects)
#/600 m³
Island ordered by Longitude (ascending)
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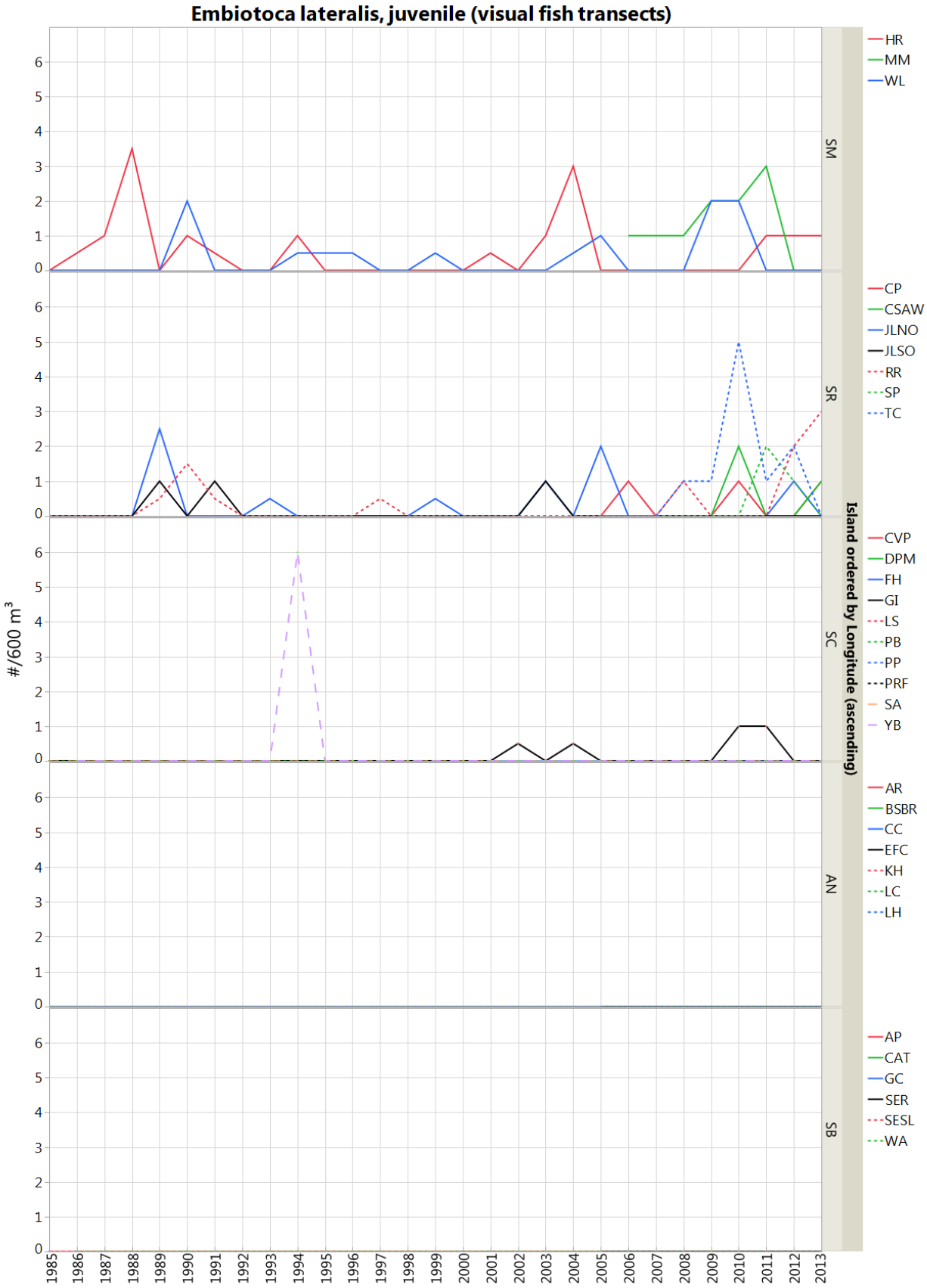

Semicossyphus pulcher, male (visual fish transects)
#/600 m³
Island ordered by Longitude (ascending)
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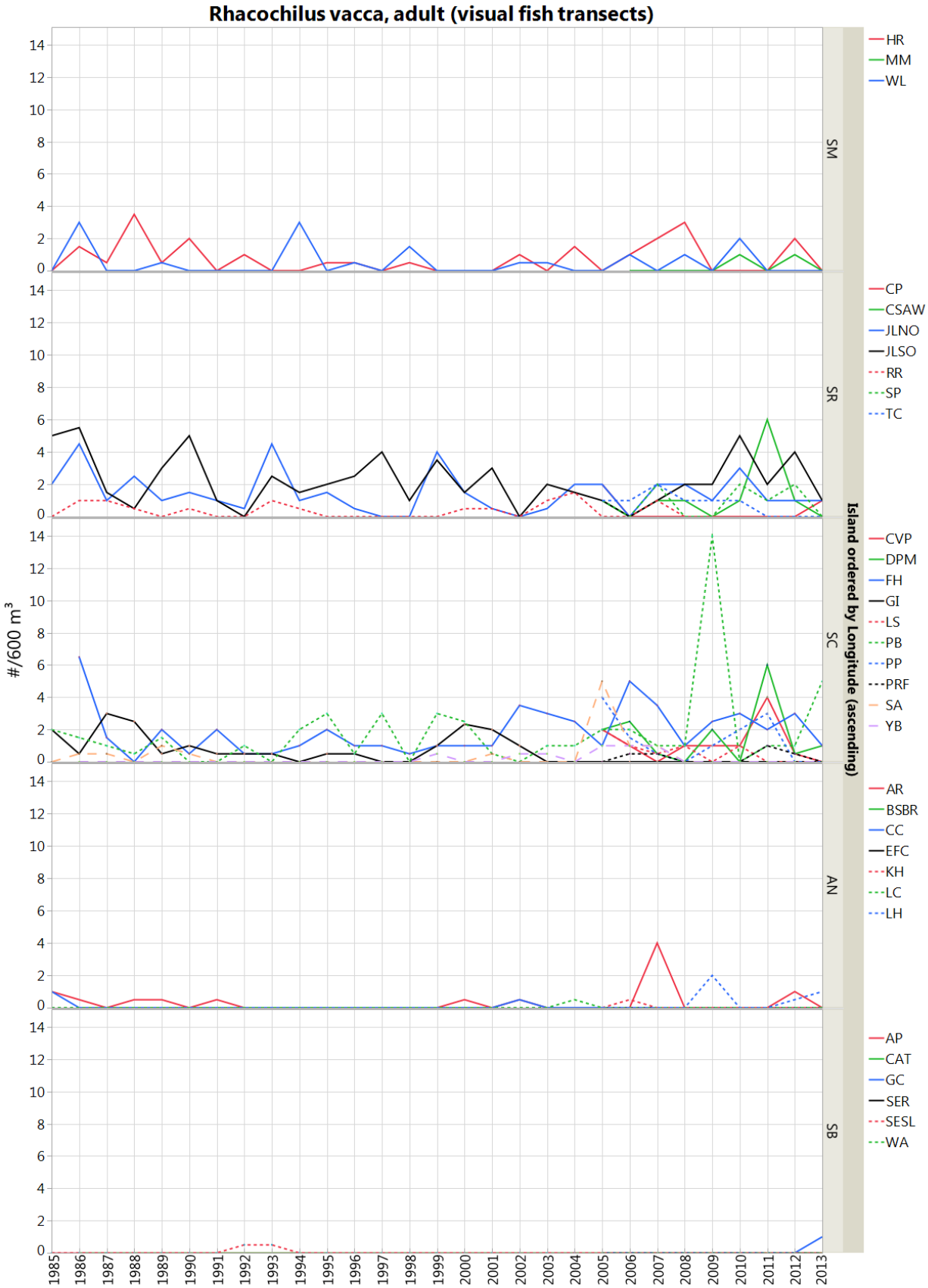

Semicossyphus pulcher, juvenile (visual fish transects)
#/600 m³
Island ordered by Longitude (ascending)
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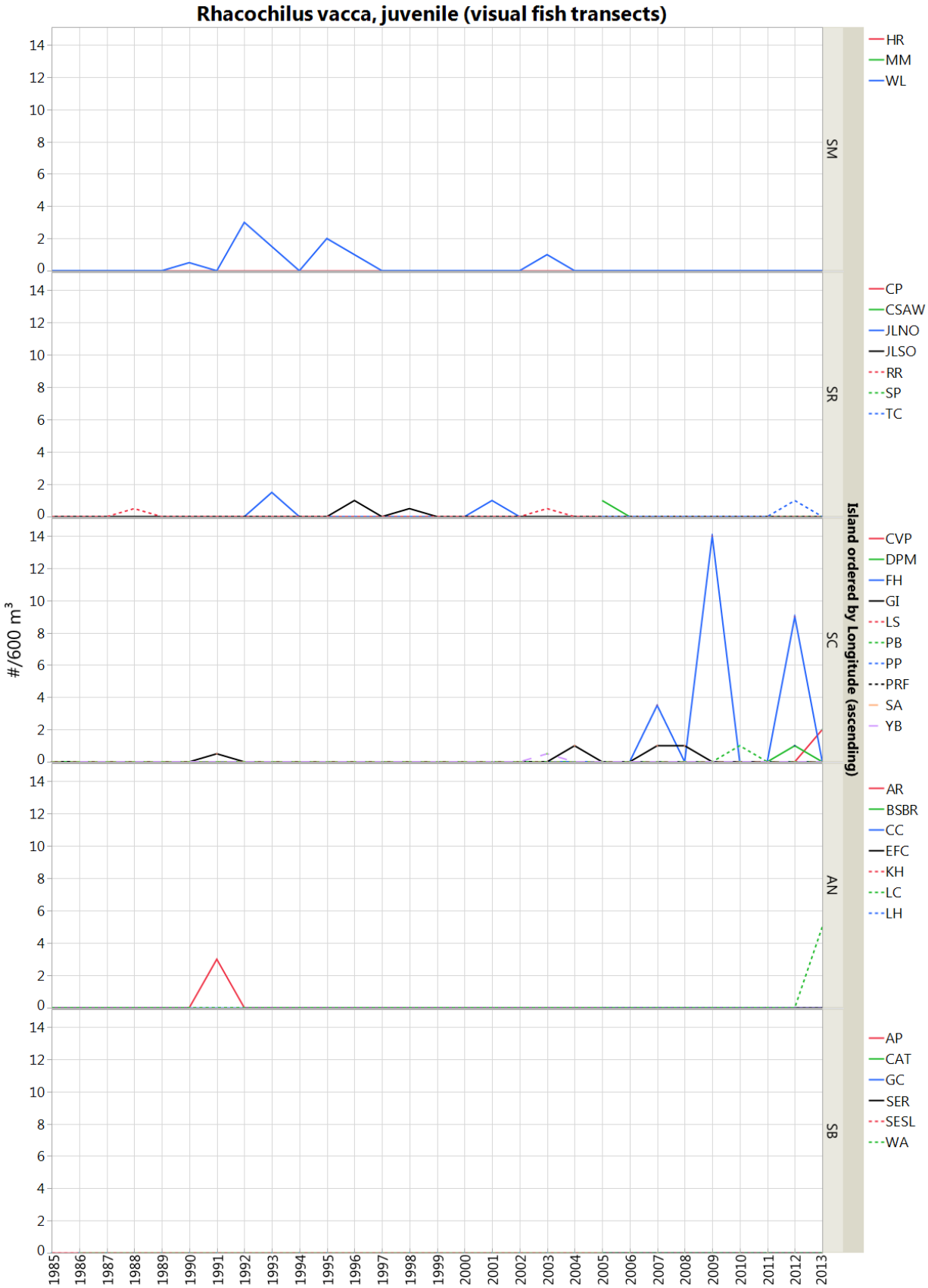

Embiotoca jacksoni, adult (visual fish transects)
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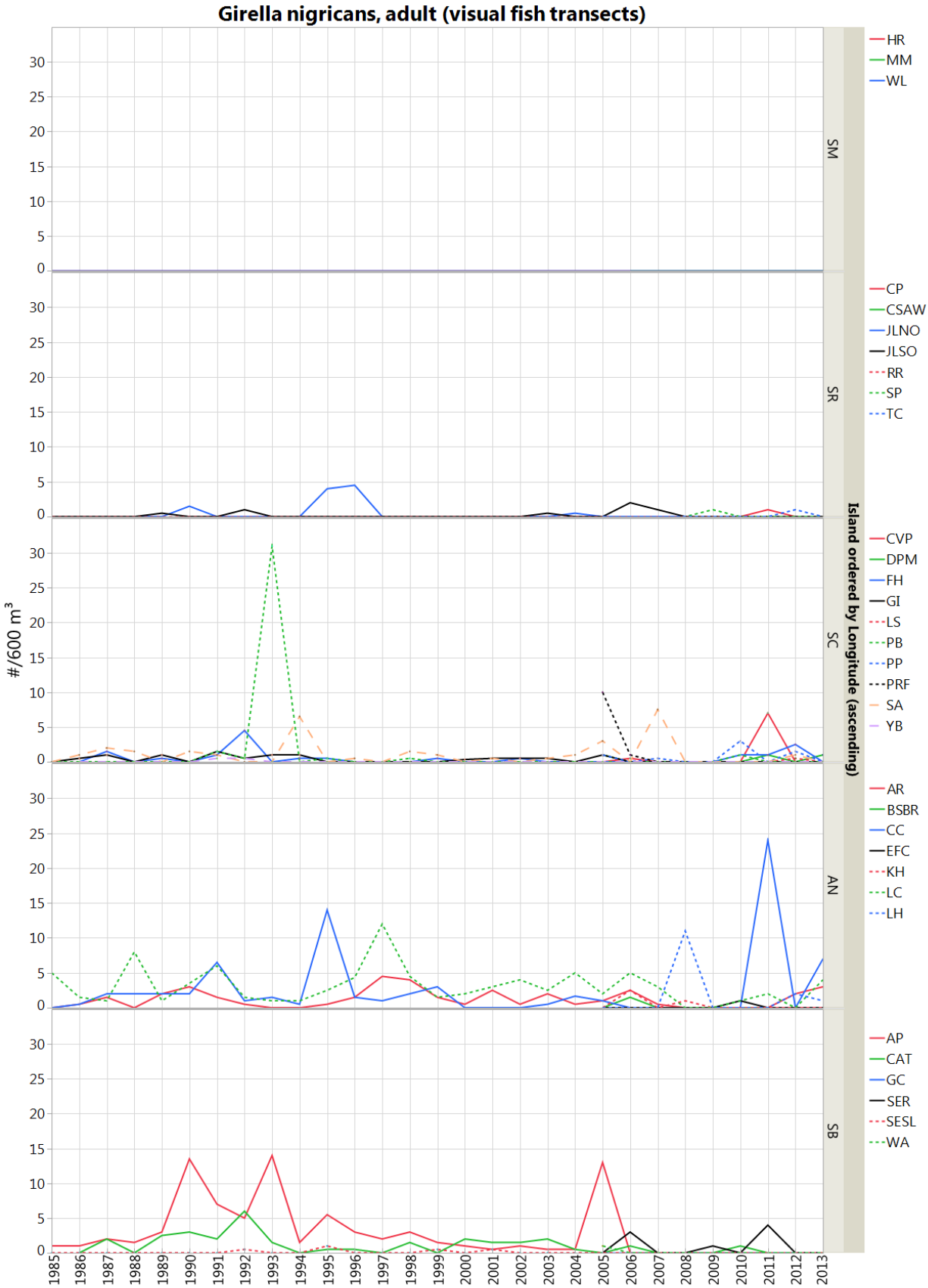

Embiotoca jacksoni, juvenile (visual fish transects)
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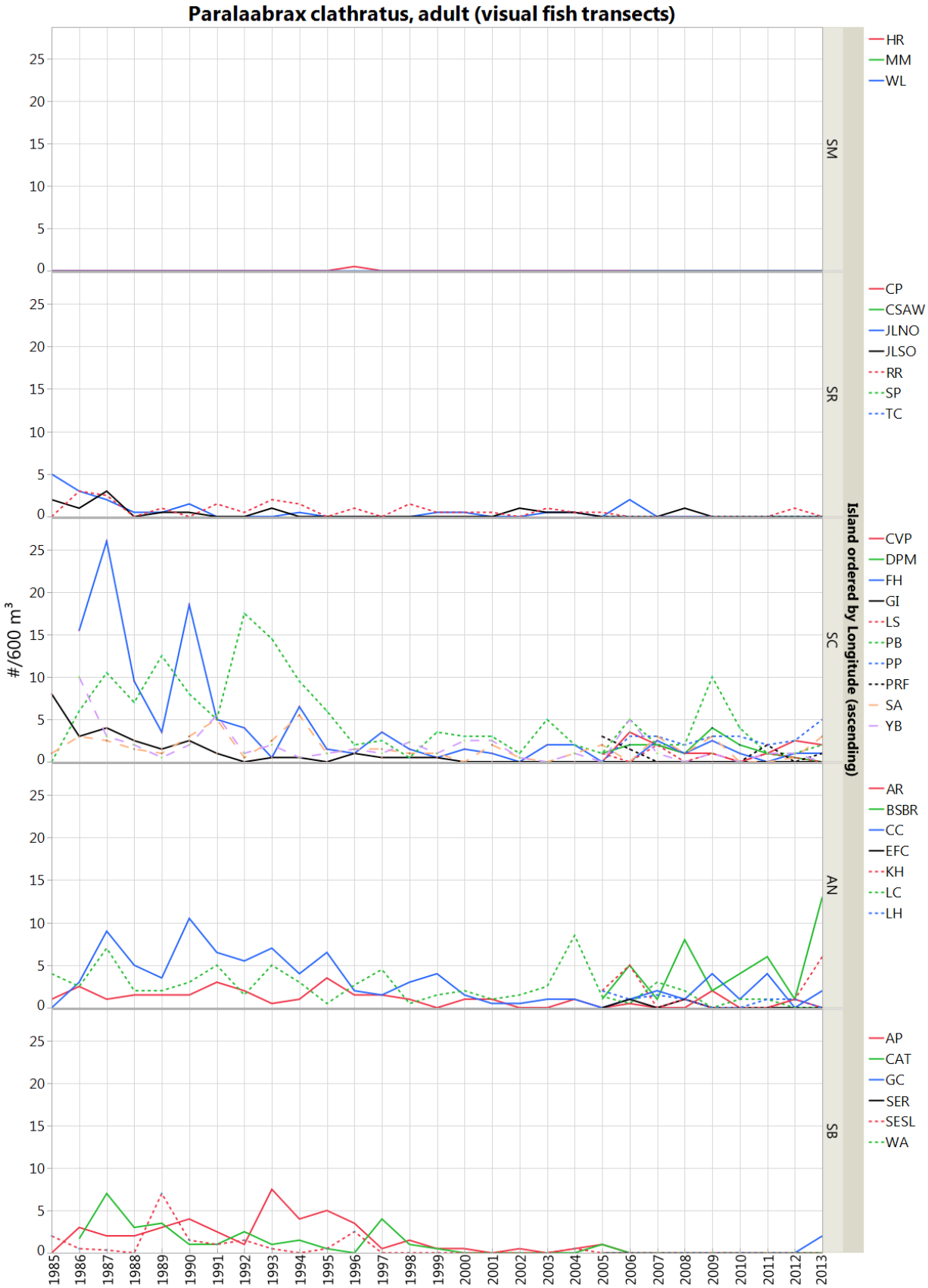

Embiotoca lateralis, adult (visual fish transects)
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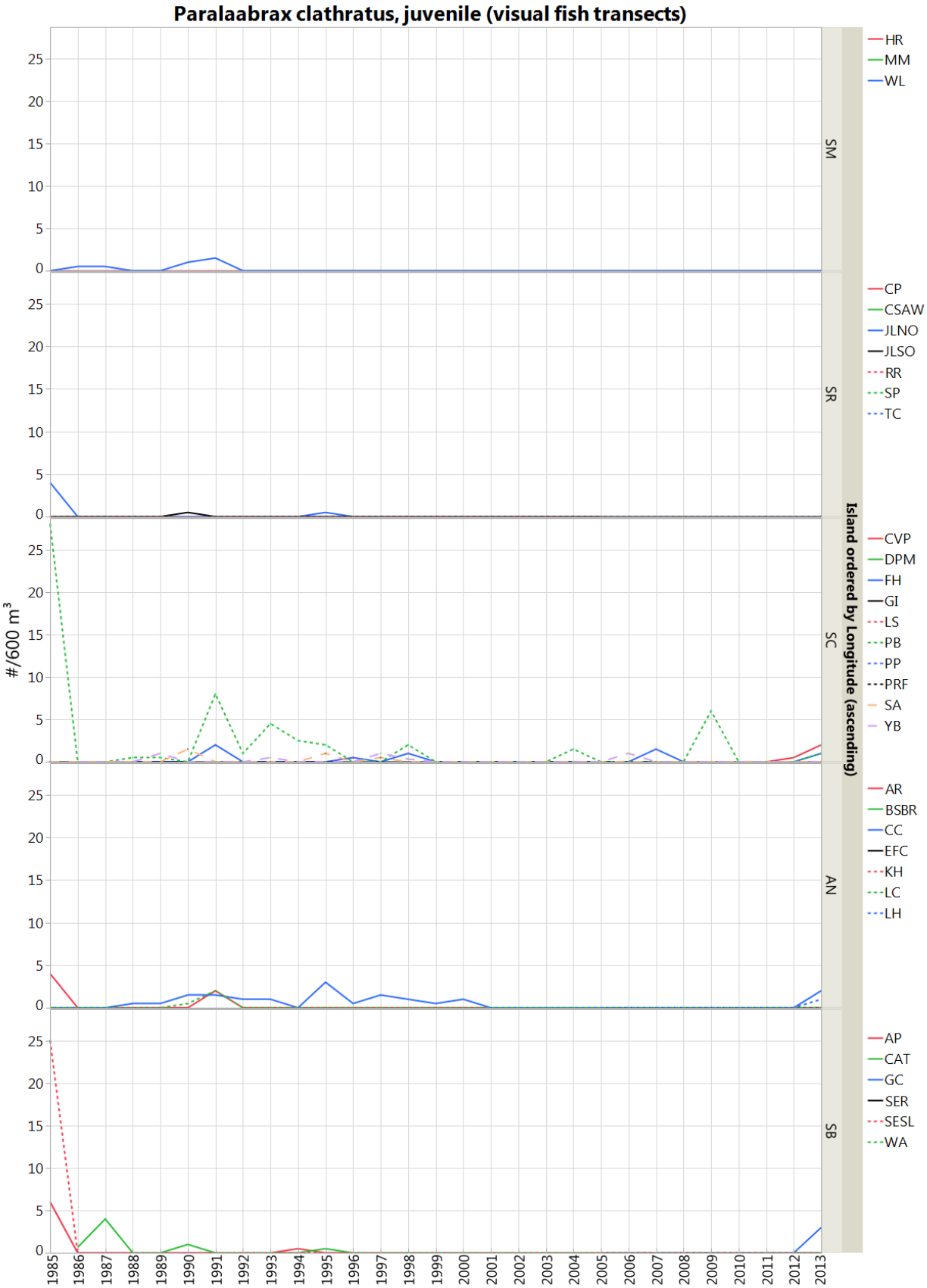

Embiotoca lateralis, juvenile (visual fish transects)
#/600 m³
Island ordered by Longitude (ascending)
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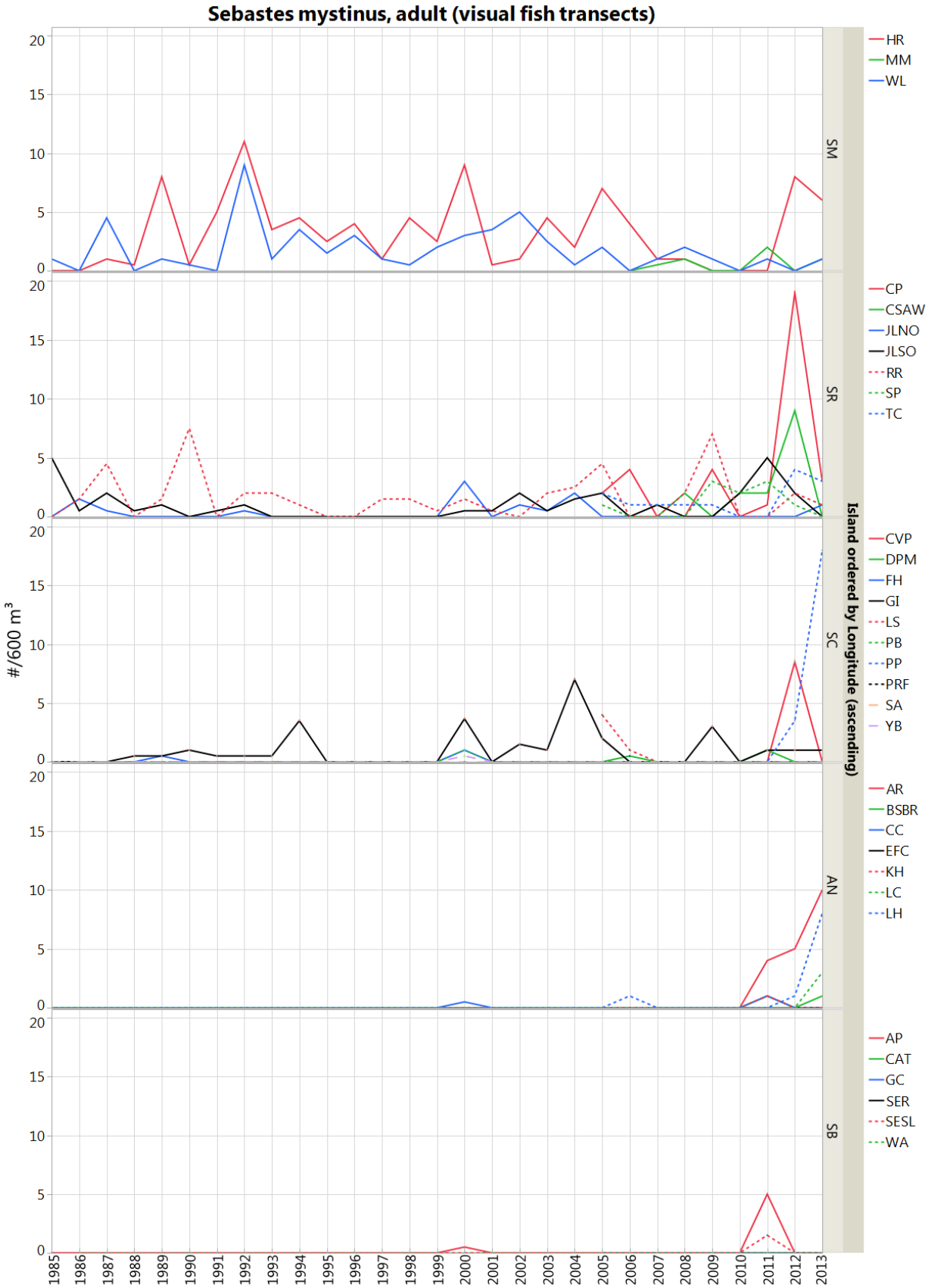

Rhacochilus vacca, adult (visual fish transects)
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Island ordered by Longitude (ascending)
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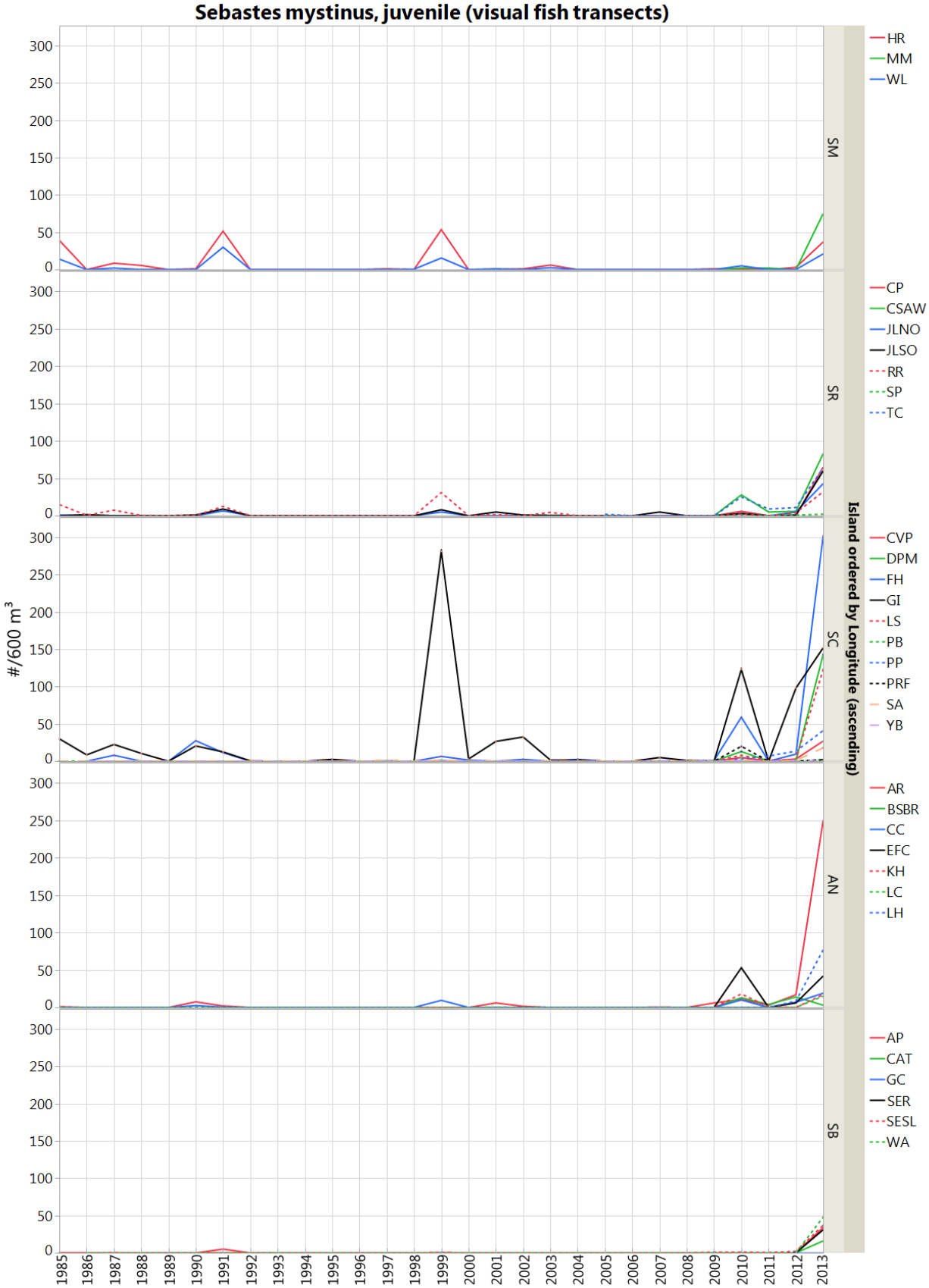

Rhacochilus vacca, juvenile (visual fish transects)
#/600 m³
Island ordered by Longitude (ascending)
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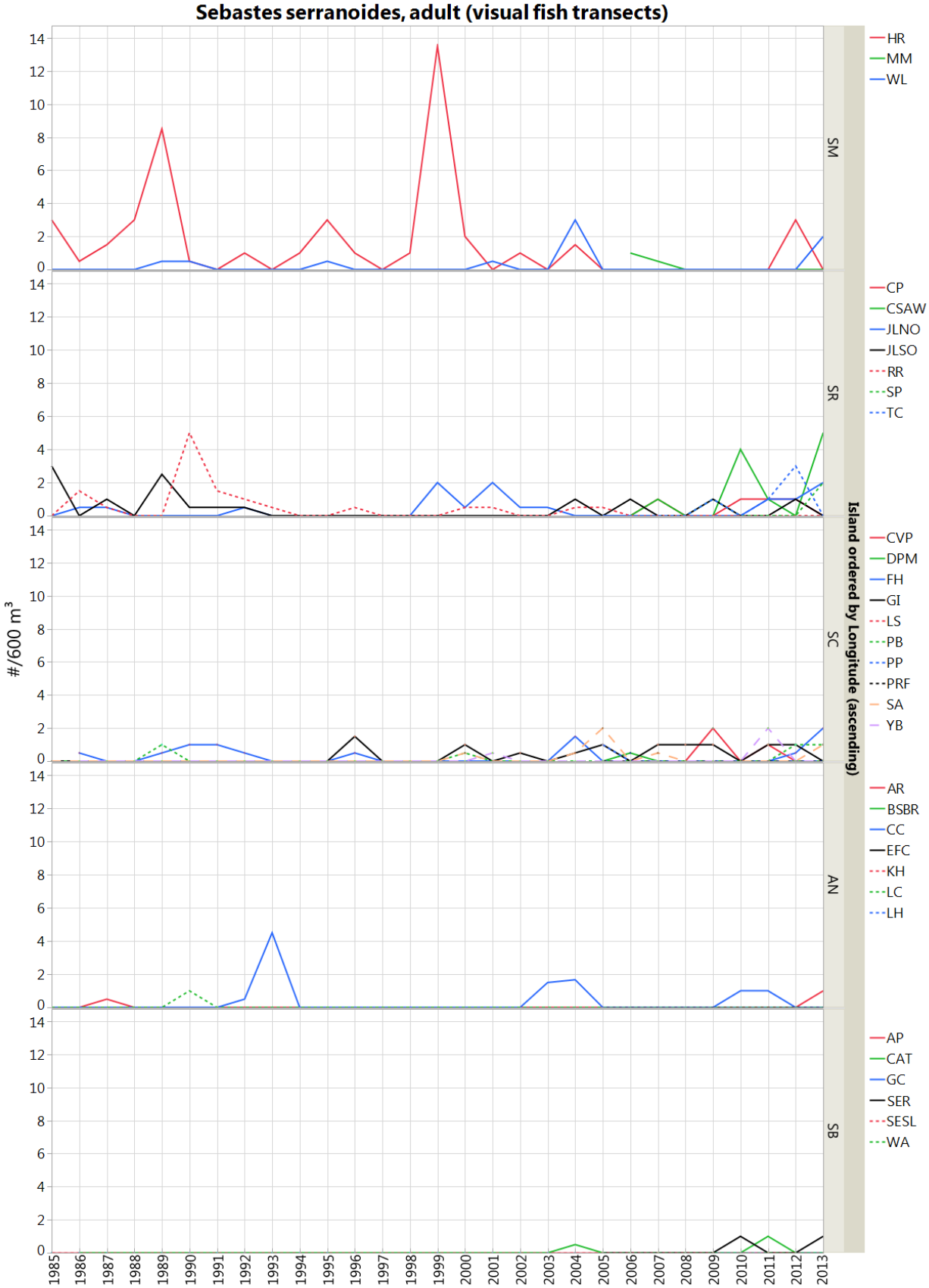

Girella nigricans, adult (visual fish transcripts)
#/600 m³
Island ordered by Longitude (ascending)
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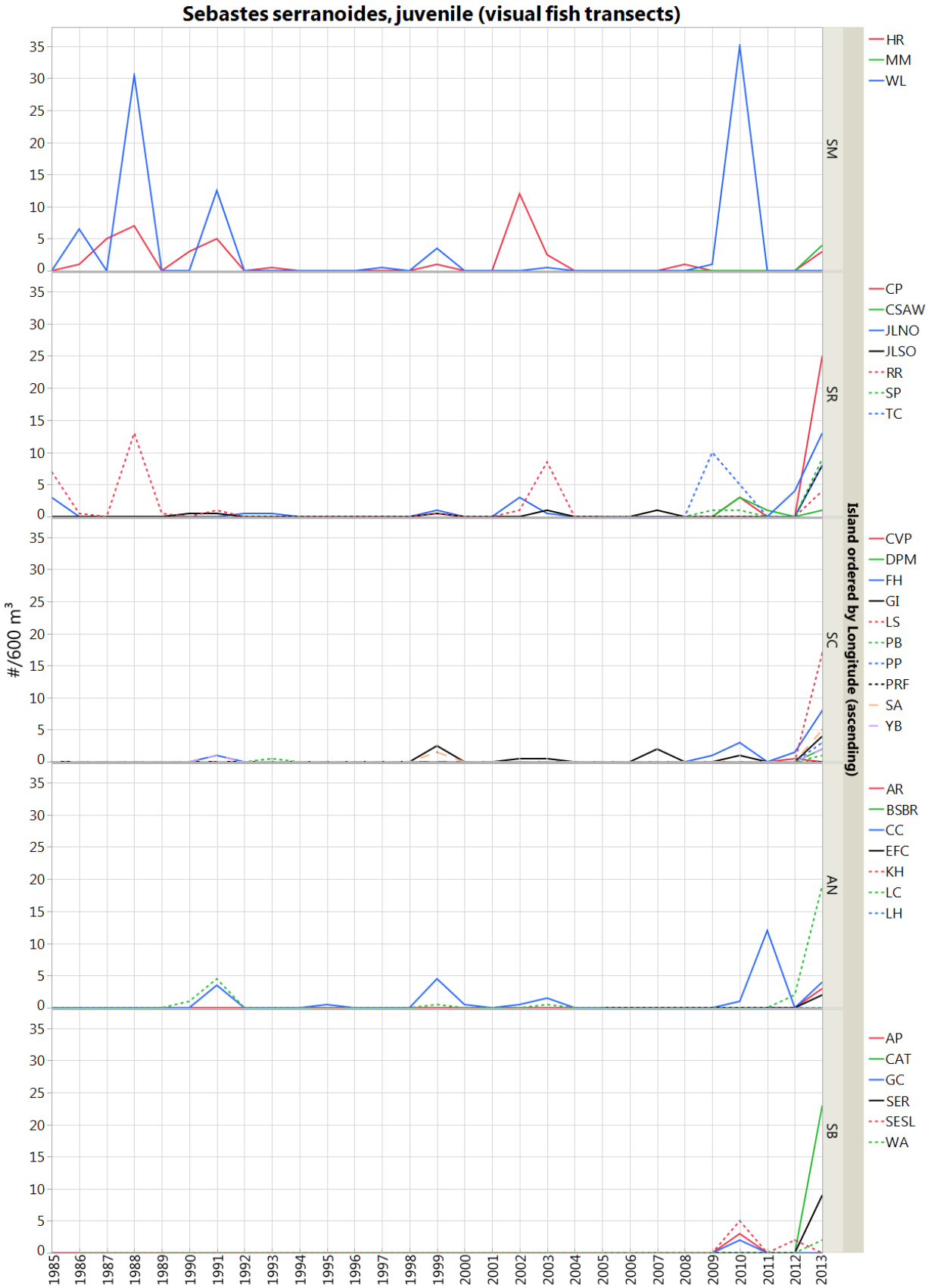

Paralaabrax clathratus, adult (visual fish transcects)
#/600 m³
Island ordered by Longitude (ascending)
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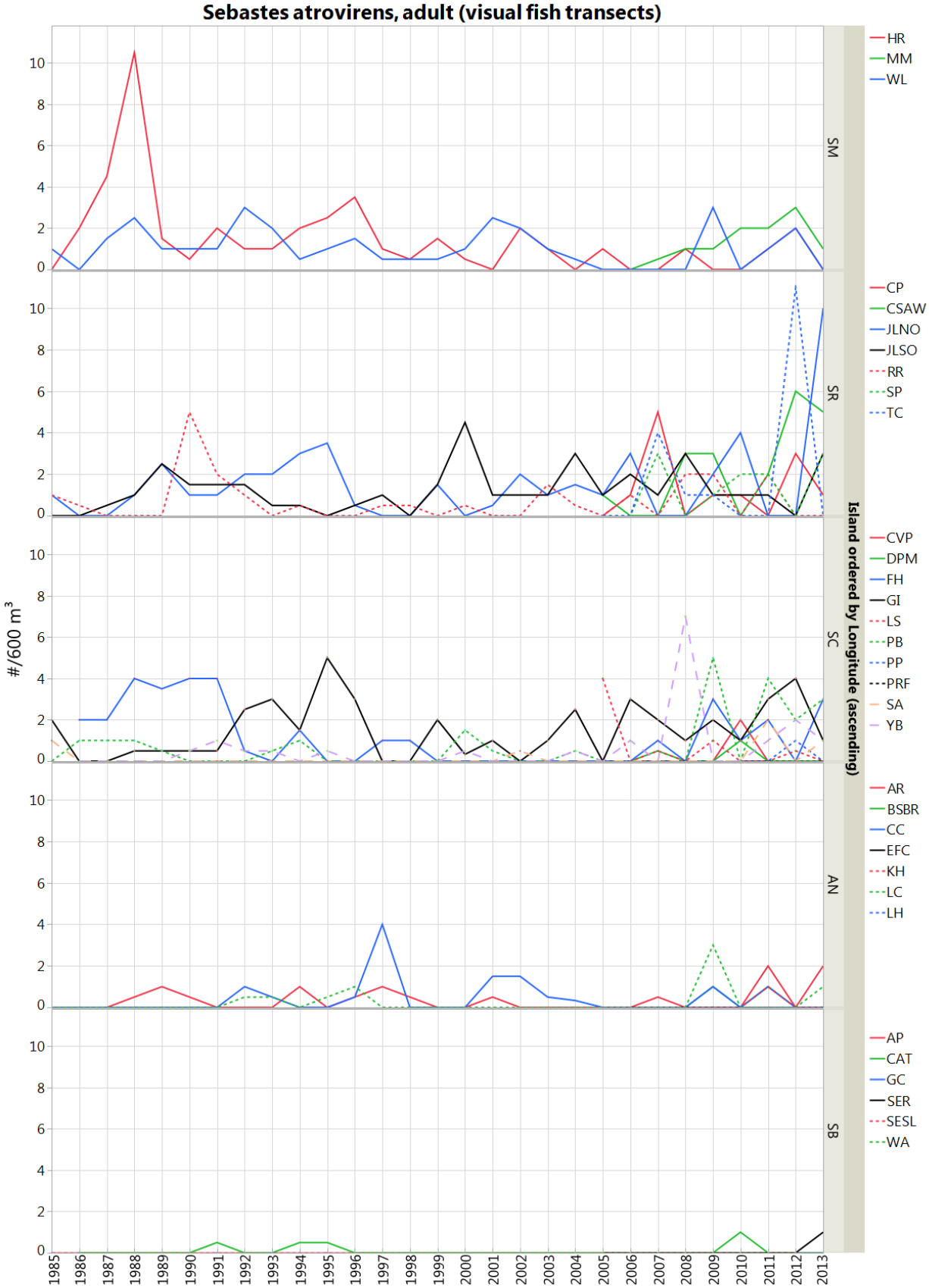

Paralaabrax clathratus, juvenile (visual fish transects)
#/600 m³
Island ordered by Longitude (ascending)
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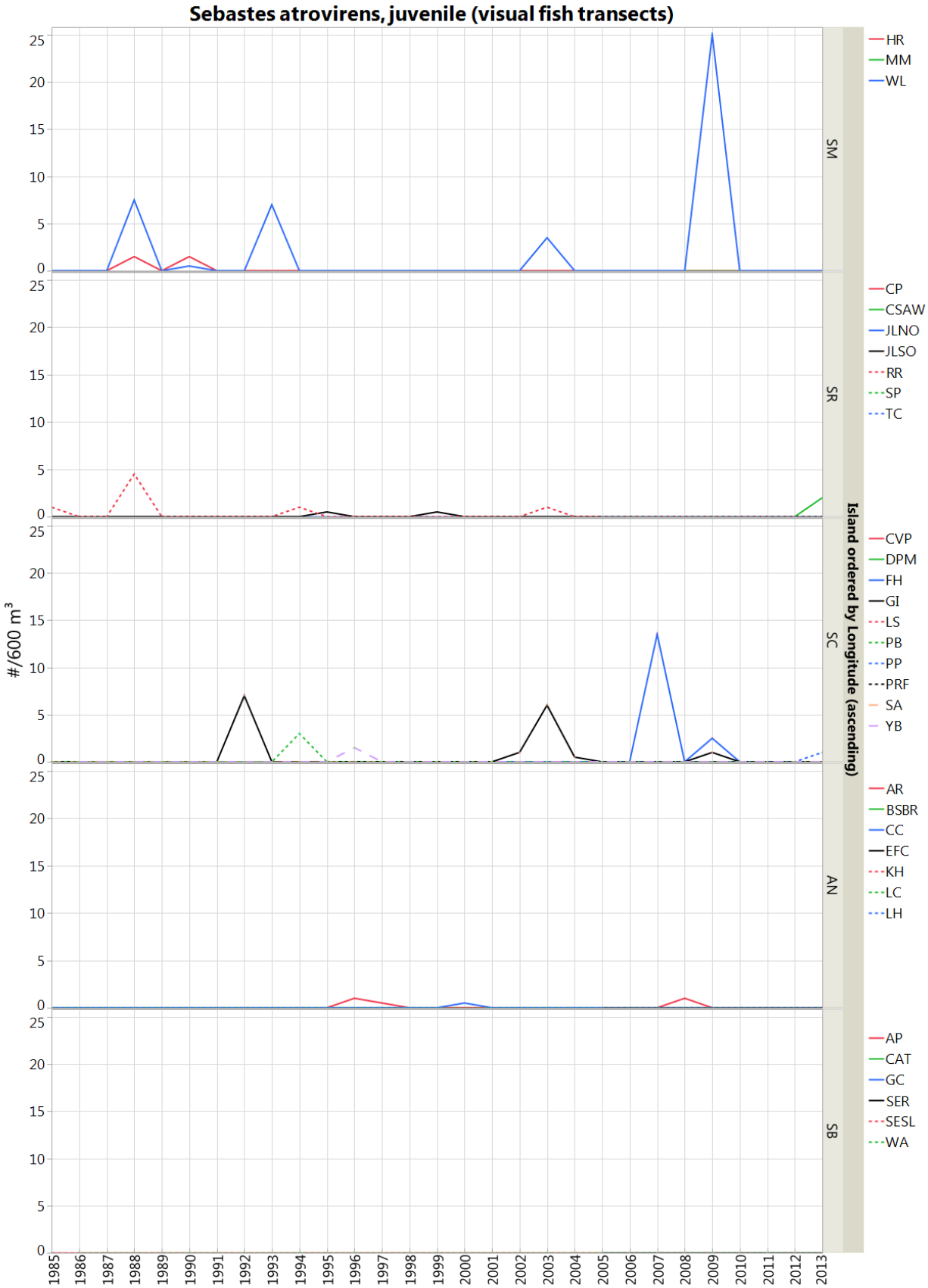

Sebastes mystinus, adult (visual fish transcects)
#/600 m³
Island ordered by Longitude (ascending)
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SESL
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2012
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Sebastes mystinus, juvenile (visual fish transects)
#/600 m³
Island ordered by Longitude (ascending)
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AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
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CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
AP
CAT
GC
SER
SESL
WA
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50
100
150
200
250
300
1985
1986
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2012
2013


Sebastes serranoides, adult (visual fish transects)
#/600 m³
Island ordered by Longitude (ascending)
SM
SR
SC
AN
SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
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BSBR
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EFC
KH
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CAT
GC
SER
SESL
WA
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4
6
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Sebastes serranoides, juvenile (visual fish transects)
#/600 m³
Island ordered by Longitude (ascending)
SM
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JLSO
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CVP
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PB
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BSBR
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SER
SESL
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Sebastes atrovirens, adult (visual fish transects)
#/600 m³
Island ordered by Longitude (ascending)
SM
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SC
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SB
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WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
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YB
AR
BSBR
CC
EFC
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LH
AP
CAT
GC
SER
SESL
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Sebastes atrovirens, juvenile (visual fish transcects)
#/600 m³
Island ordered by Longitude (ascending)
SM
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SC
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SB
HR
MM
WL
CP
CSAW
JLNO
JLSO
RR
SP
TC
CVP
DPM
FH
GI
LS
PB
PP
PRF
SA
YB
AR
BSBR
CC
EFC
KH
LC
LH
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CAT
GC
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Appendix J. Survey Dives

05/16/2013
Shag Rock, Santa Barbara Island
In approximately 15–35 ft of water, we observed 10 *Squatina californica,* Pacific angel shark, as well as three medium-sized (25–32 inches) *Paralichthys californicus*, California halibut. One abandoned, closed lobster trap was found with two lobsters and one brown rockfish, *Sebastes auriculatus*, inside. We removed one of the entry ports on the trap.

05/28/2013
Inshore of Yellowbanks, Santa Cruz Island
33° 59.534, 119° 33.490

This dive was conducted to practice sizing fish. *Parastichopus parvimensis* were noted as being abundant, perhaps more abundant than the KFM sites inside of the Scorpion MPA. However, they were patchy, being mostly located around rock piles. Most of the substrate consisted of sand. One *Haliotis rufescens* was found at about 155 mm in size.

05/29/2013
Albert's, Santa Cruz Island
The wind was again high early in the day with moderate wind swell, and we decided we could not sample any sites. We transited to Albert's where we could hide from the wind and conditions were manageable. Several people went to shore and the rest made dives. Juvenile *Sebastes semicinctus*, halfbanded rockfish, and *Sebastes saxicola*, stripetailed rockfish, were common at 70 ft in the anchorage.

6/11/2013
East of Shag Rock, Santa Barbara Island
While prepping chickens for the night's dinner, David Kushner dropped one whole chicken into the water. Several divers went in the water several minutes later to retrieve it and found that a *Stereolepis gigas*, giant black sea bass, had already begun eating it. Most of the chicken was retrieved and most of the incident was caught on video.

7/18/2013
Between Moore Meadows and Blue Banks, Santa Cruz Island
One small (approximately 60 lbs) *Stereolepis gigas*, giant black sea bass, was observed. Six juvenile *Chromis punctipinnis* were observed as well. This is the first sighting of YOY this season. Additionally, *Porpita porpita*, pelagic blue button, were observed. This is the first time in several years that David Kushner (Park marine biologist) has observed this species.

8/27/2013
West of Pedro Point, Santa Cruz Island
Area below reef was mostly *Ophiothrix spiculata*. There were very few large fish.

8/28/2013

East of Potato Pasture, Santa Cruz Island

David Kushner snorkeled in the cobble field 200 m east of the KFM site to look for Haliotis cracherodii, black abalone. Approximately 75 were counted, with most between 100–150 mm. A few larger individuals were present. Inshore, in about three feet of water, there were at least 40 juveniles observed (15–60 mm) underneath large boulders.

8/30/2013

Rat Rock, Anacapa Island

A deep survey dive was conducted. The area was dominated by *Strongylocentrotus purpuratus*. There was a small amount of algae on tops of large rocks shallower that 35 ft. and also in areas less than 20 ft. deep. Below 45 ft, the area was dominated by *Ophiothrix spiculata*. Between 80 and 110 ft., the bottom was 50% covered with squid eggs, with the rest dominated by *O. spiculata*. *Macrocystis pyrifera*, *Gigartina* sp., and *Laurencia pacifica* were collected for a white abalone food study that Tom McCormick is working on.

9/19/2013

Inshore of Rodes Reef, Santa Rosa Island

A survey dive was conducted inshore of Rodes Reef. There was a large aggregation (hundreds) of *Melibe leonina* on kelp blades about 15 ft. below the surface. Also, there was a notable amount of large *Semicossyphus pulcher*, California sheephead, present.

09/20/13

East of West Cove, Santa Cruz Island: Survey dive.

Arch Rock, Santa Cruz Island: Survey dive.

10/22/13

Scorpion Pier, Santa Cruz Island: Zostera sp., eel grass, and Haliotis cracherodii surveys were completed in preparation for construction of the new pier.

Appendix K. General Comments, Suggestions, Unusual Species, and Interesting Observations

Unusual Species

We did not observe *Pteria sterna*, pearl oyster, at any of our sites this year. Sightings of this species have been steadily decreasing during the last decade. We believe this species most recently recruited primarily during the 1997/1998 El Niño, have been senescing since, and now are very rare.

The nudibranch, *Melibe leonina* were abundant at Wyckoff Ledge, San Miguel Island and Rodes Reed, Santa Rosa Island. Inshore of Rodes Reed, Santa Rosa Island, hundreds of aggregating *M. leonina* were observed. One individual was also observed at Hare Rock, San Miguel Island.

Two divers observed a green sea turtle, *Chelonia mydas*, was observed on May 31, 2013 in Landing Cove at Santa Barbara Island. The sea turtle had large gooseneck barnacles growing on it.

One juvenile oar fish, *Regalecus glesne*, was collected July 15, 2013 at the surface by hand and measured approximately 10 cm. This is an extremely rare siting and the first observed oar fish by the KFM program. Santa Cruz Island, Pedro Reef: 34° 01.302 N, 119° 31.518 W.

Non-Indicator Species

Aplysia vaccaria were observed at Fry's Harbor, Santa Cruz Island, Cathedral Cove, Anacapa Island, and Arch Point, Santa Barbara Island.

Several *Laminaria setchellii* were observed at Miracle Mile, San Miguel Island and Cluster Point, Santa Rosa Island. This is a cooler water species of algae that is rarely observed south of Point Conception.

Similar to the last several years, there continued to be high recruitment of *Balanus* spp. at many San Miguel and Santa Rosa Island sites. Barnacles in general have been very abundant the past several years.

Mysids, which were very abundant at most southern Santa Rosa and San Miguel Island sites in 2012, were virtually absent this year.

Skin ulcers, likely caused by *Vibrio damsela*, a marine bacterium, were observed on several *Chromis punctipinnis* at Admiral's Reef, Anacapa Island. These skins ulcers are usually observed on a few *C. punctipinnis* at this particular site, especially during or after persistent warm water events.

During the week of July 19th, 2013 an abundance of salps, ctenophores, heteropods were observed from Anacapa Island to Santa Rosa Island. In addition, pyrosomes were abundant at Anacapa Island. Several anemones were observed feeding on pyrosomes at Admiral's Reef, Anacapa Island.

One *Isurus oxyrinchus*, mako shark, was observed feeding on a sea lion on October 21, 2013 while the vessel "Sea Ranger" was transiting between Gull Island and Morse Point near Santa Cruz Island.

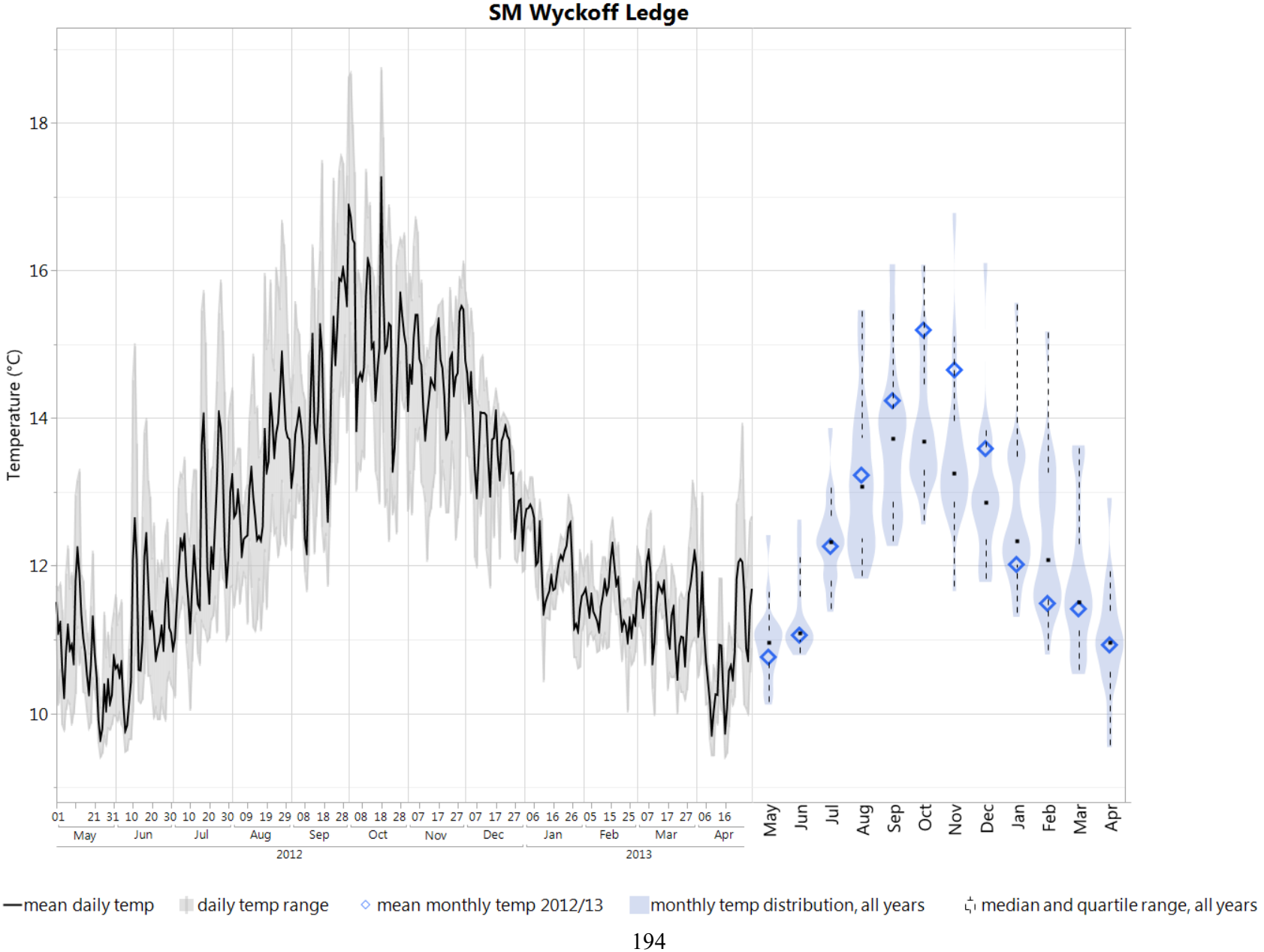
General comments, suggestions, interesting or unusual observations

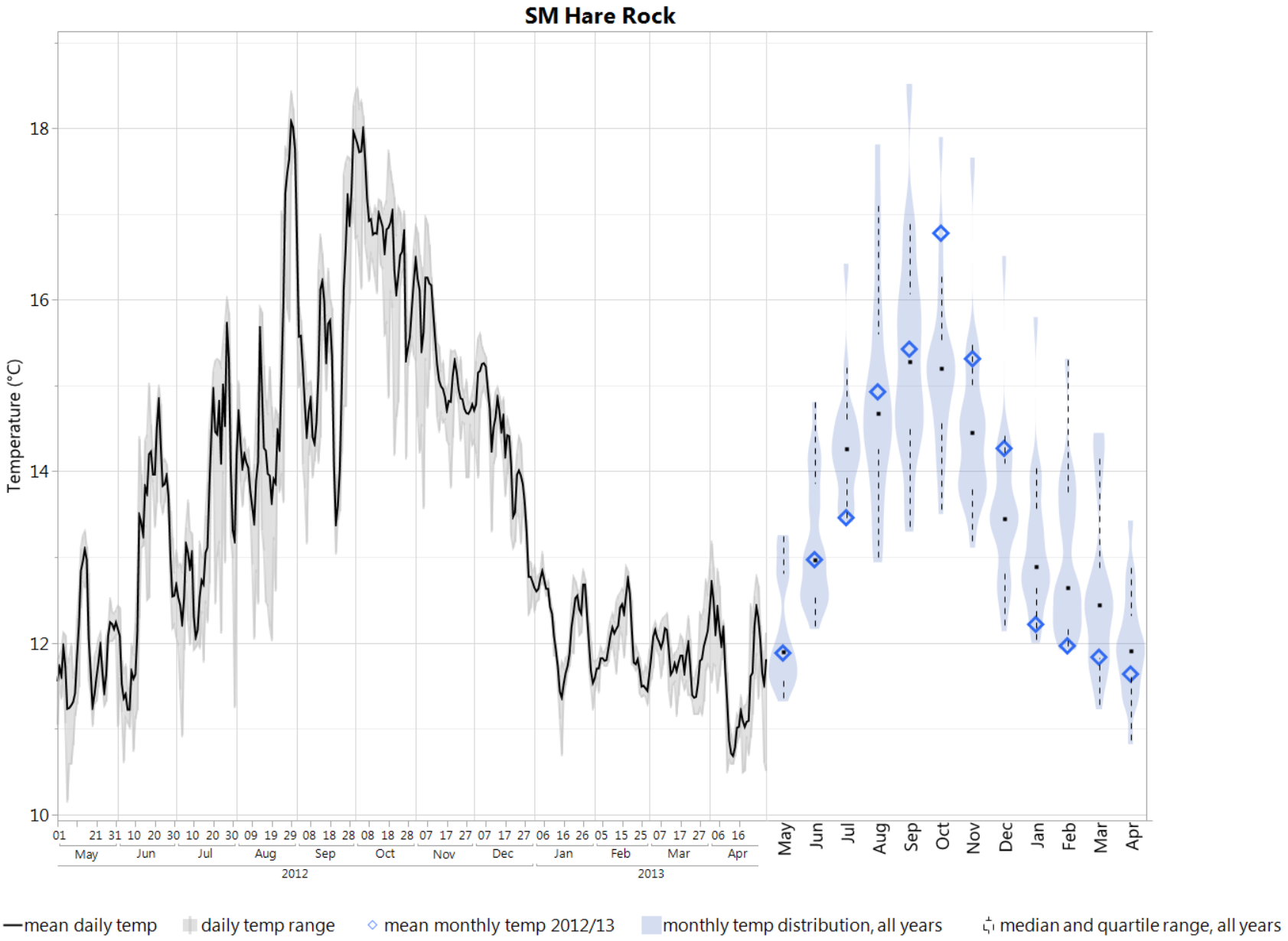
On May 31, 2013 at Lighthouse, Anacapa Island two abandoned lobster traps were found on the transect. Both had metal clips which prevented the trap from self-destructing. The diver who initially found the traps could not pry the trap door open. Note, this is over two months since the commercial lobster season closed and these traps should not have been abandoned let alone continued to fish. Two large sheep crabs, *Loxorhynchus* grandis, and one *Embiotoca jacksoni* were eventually freed from the traps.

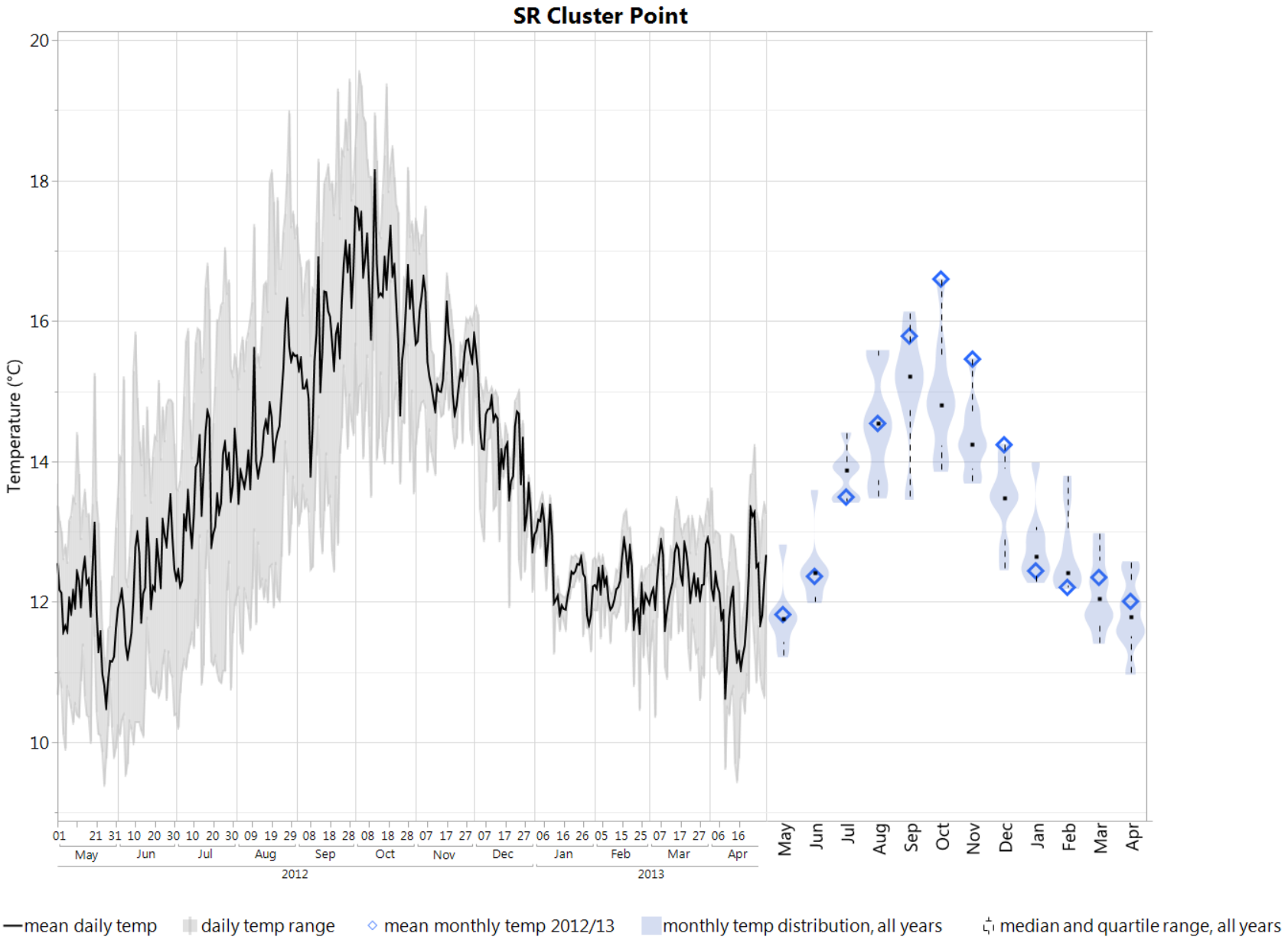
On May 16, 2013 at Shag rock, Santa Barbara Island an abandoned, closed lobster trap was found with two lobsters and one brown rockfish, *Sebastes auriculatus*, inside. We removed one of the entry ports on the trap to free these trapped animals. Again, these traps should not have been fishing and removed since it was two months past the closure of the commercial lobster season.

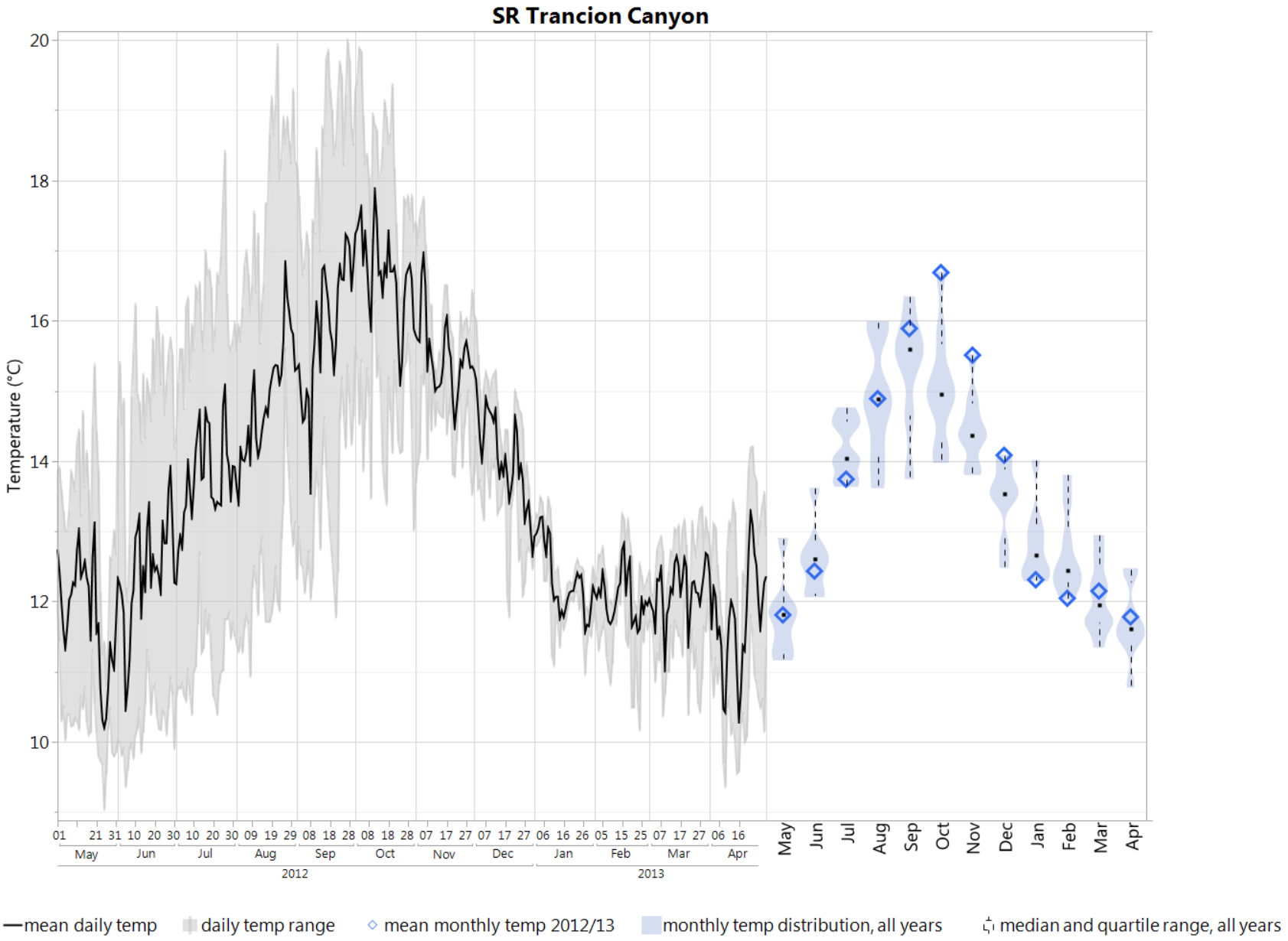
Appendix L. Temperature Data by Site

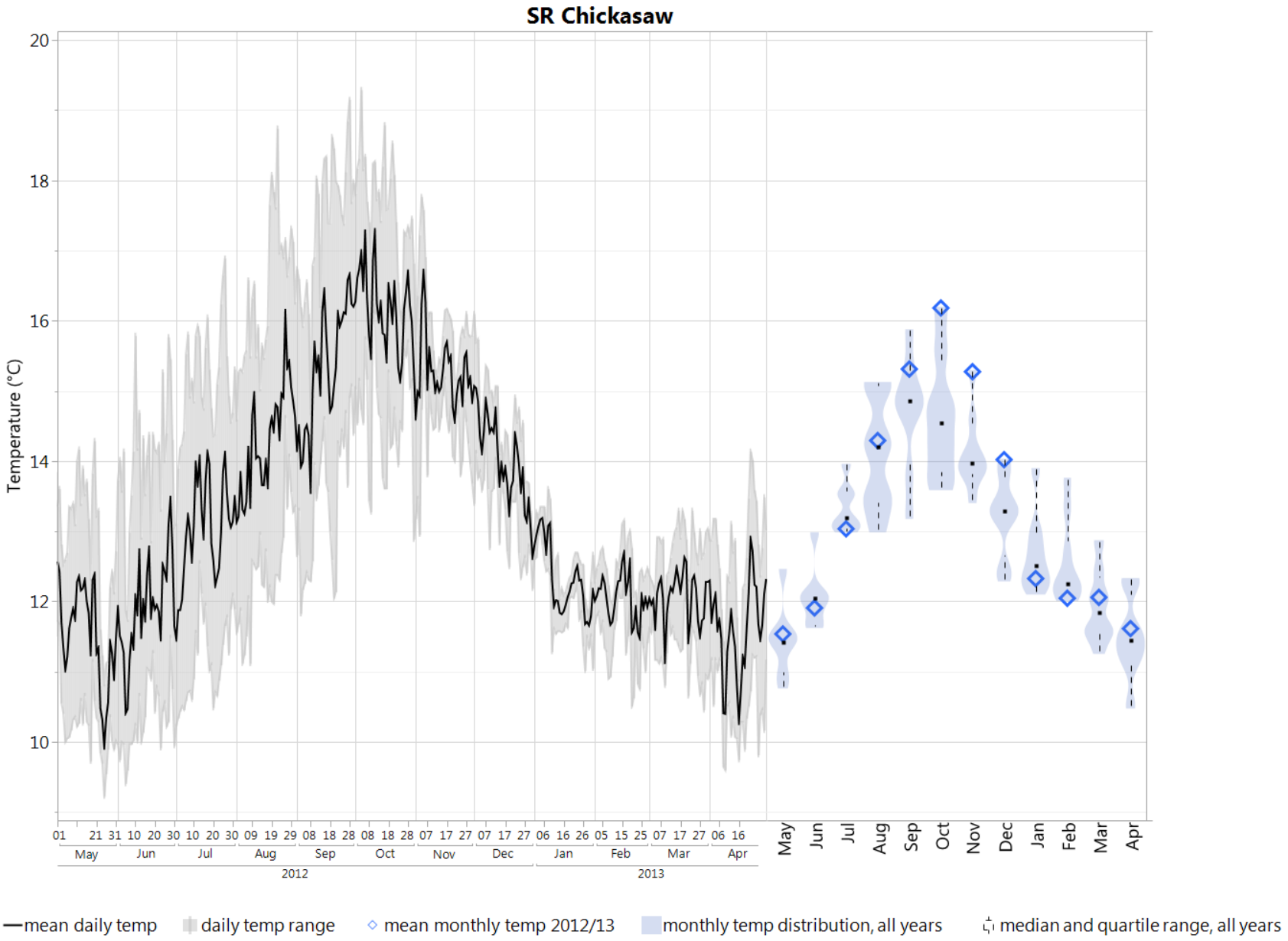
The temperature graphs are divided into a right graph and left graph. The left graph displays the mean daily temperature, as well as the daily temperature range, for the current year. The right graph displays temperature values for the current year compared to past years. Blue diamonds indicate the mean monthly temperatures for the current year. Violin plots indicate the distribution of all past years monthly mean temperature values. If more than seven days of temperature values are missing from any month, due to instrument loss or failure, all temperature values for that particular month/year are excluded. Graphs are ordered by site longitude, from west to east.

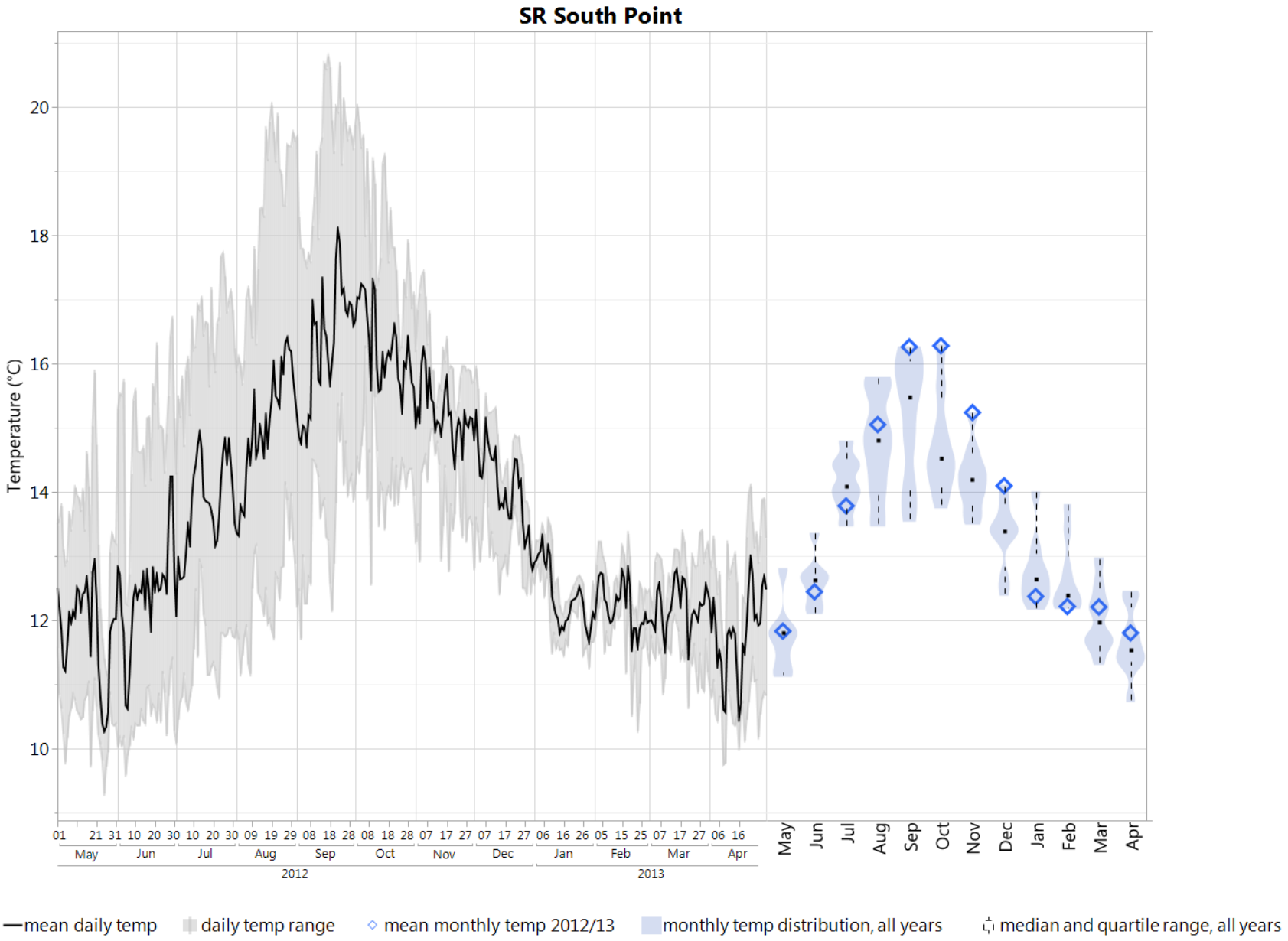

SM Wyckoff Ledge
Temperature (°C)
18
16
14
12
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01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

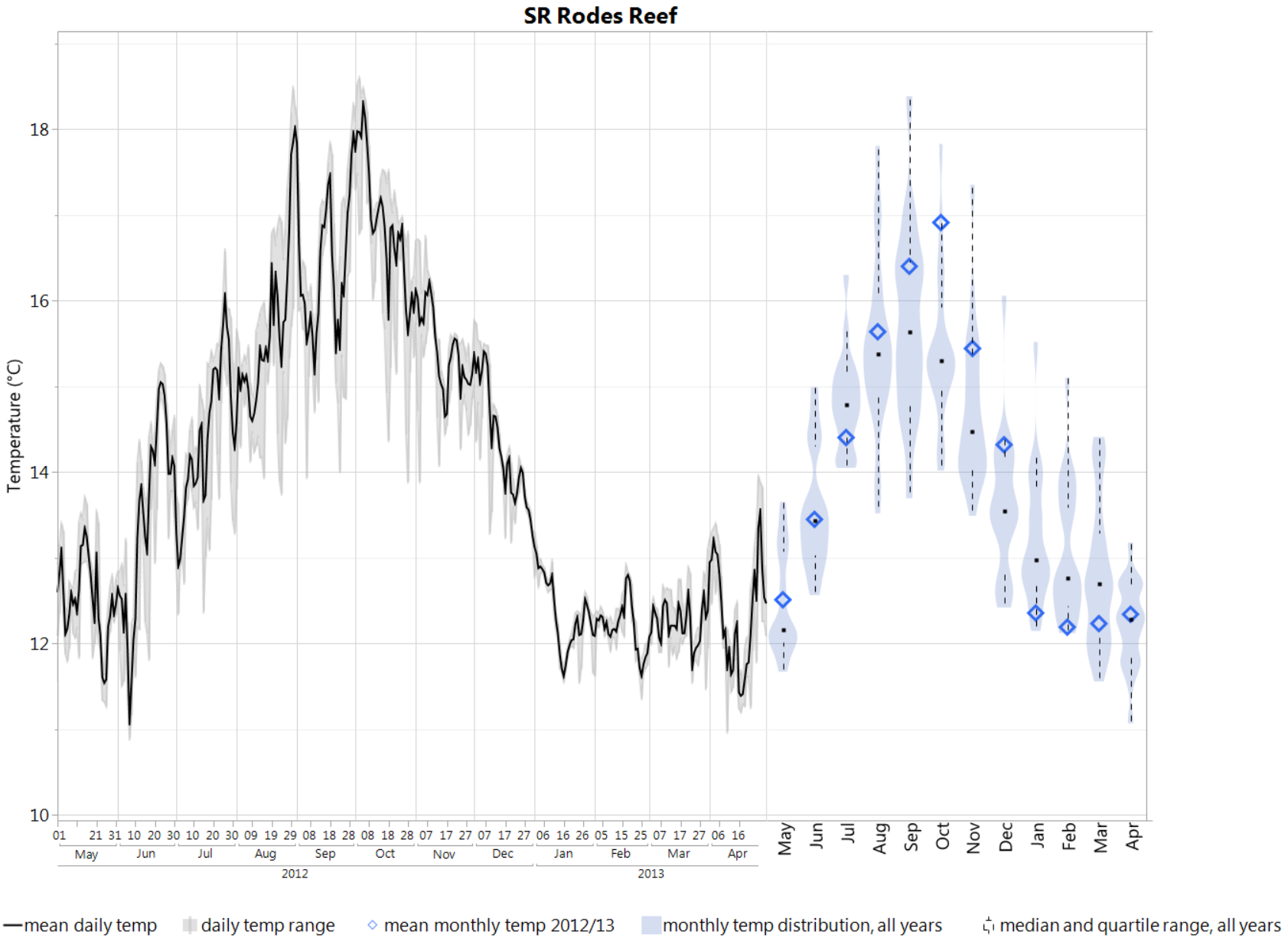

SM Hare Rock
Temperature (°C)
18
16
14
12
10
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

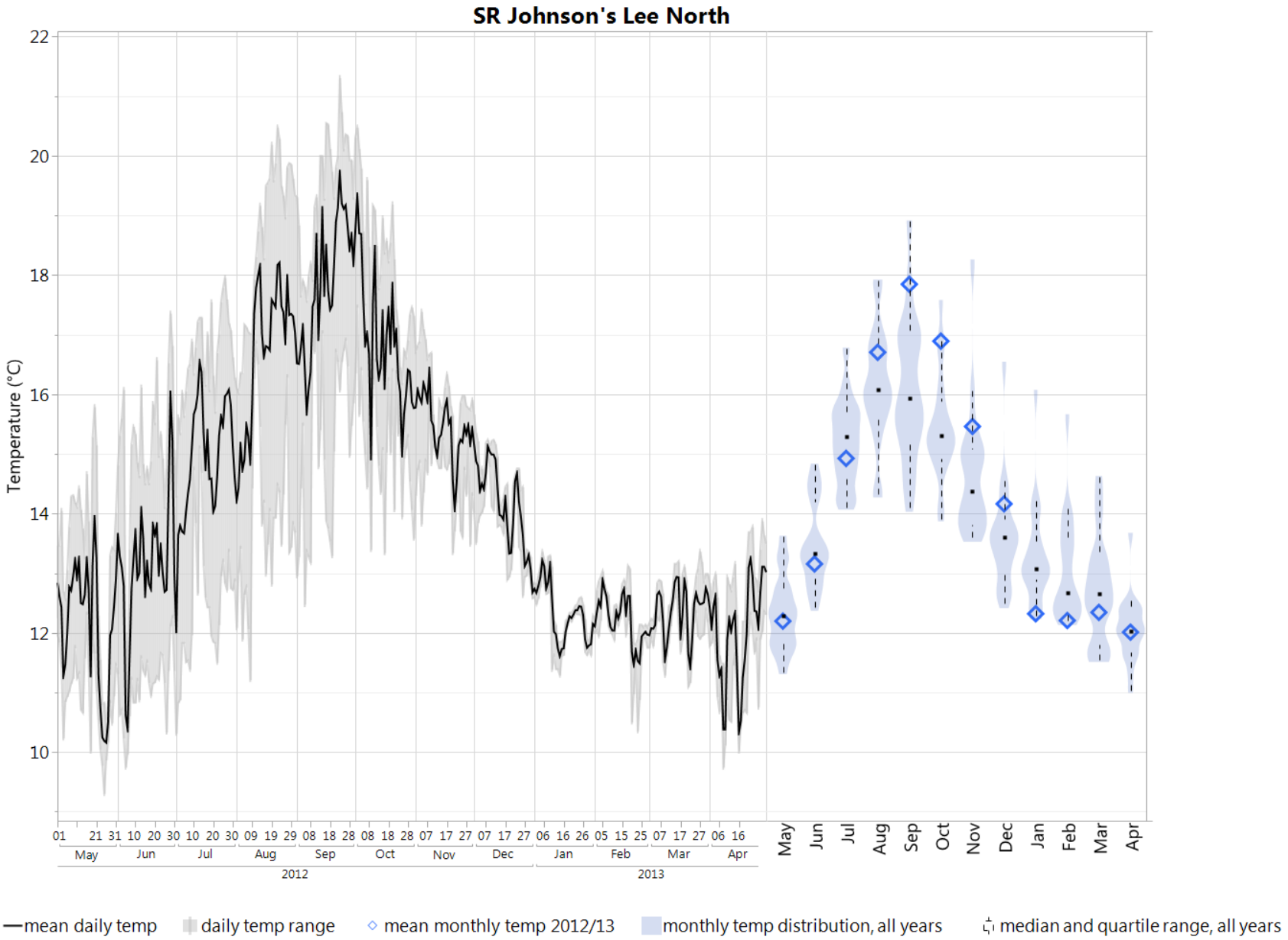

SR Cluster Point
Temperature (°C)
20
18
16
14
12
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01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

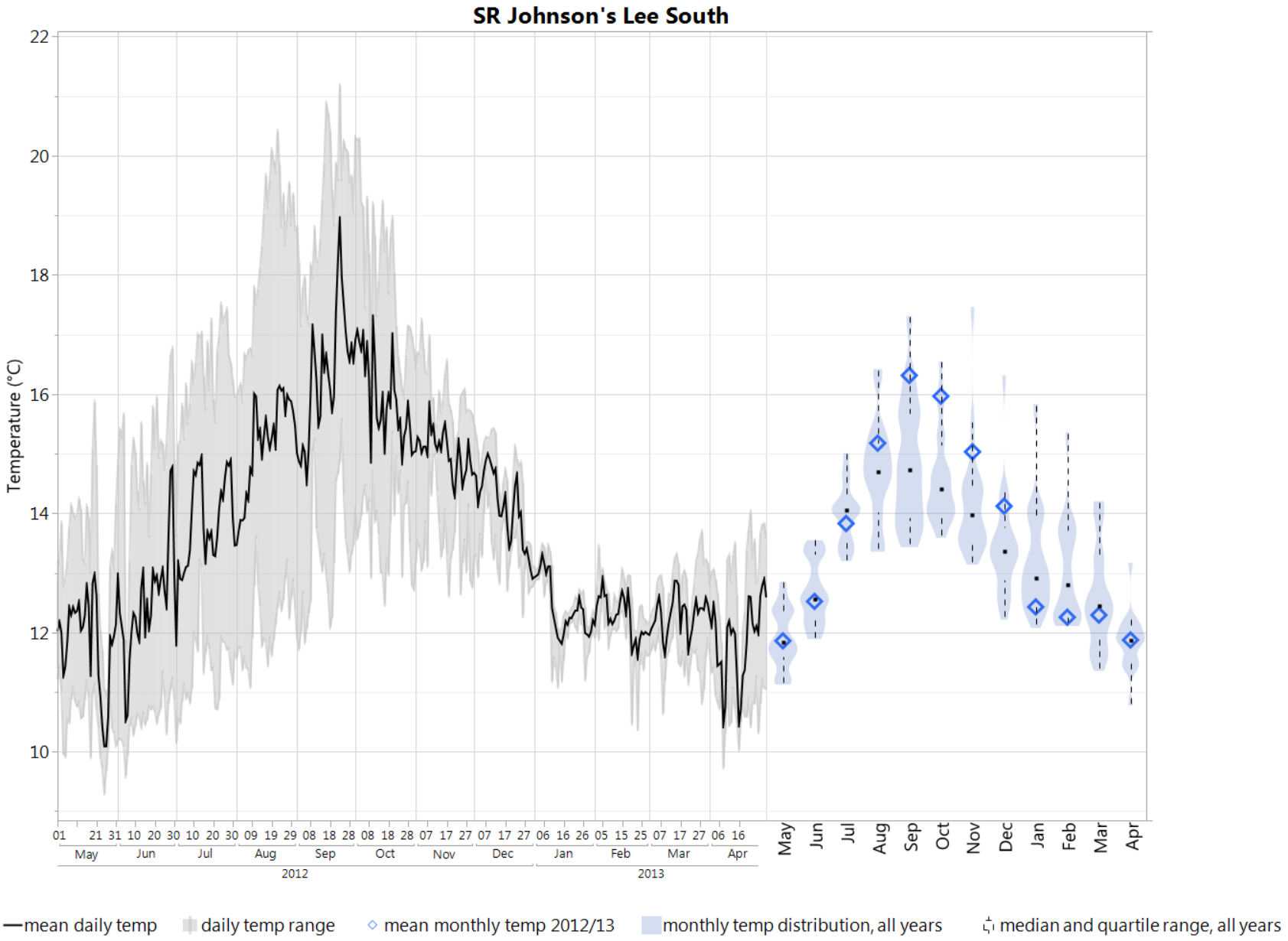

SR Trancion Canyon
Temperature (°C)
20
18
16
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01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

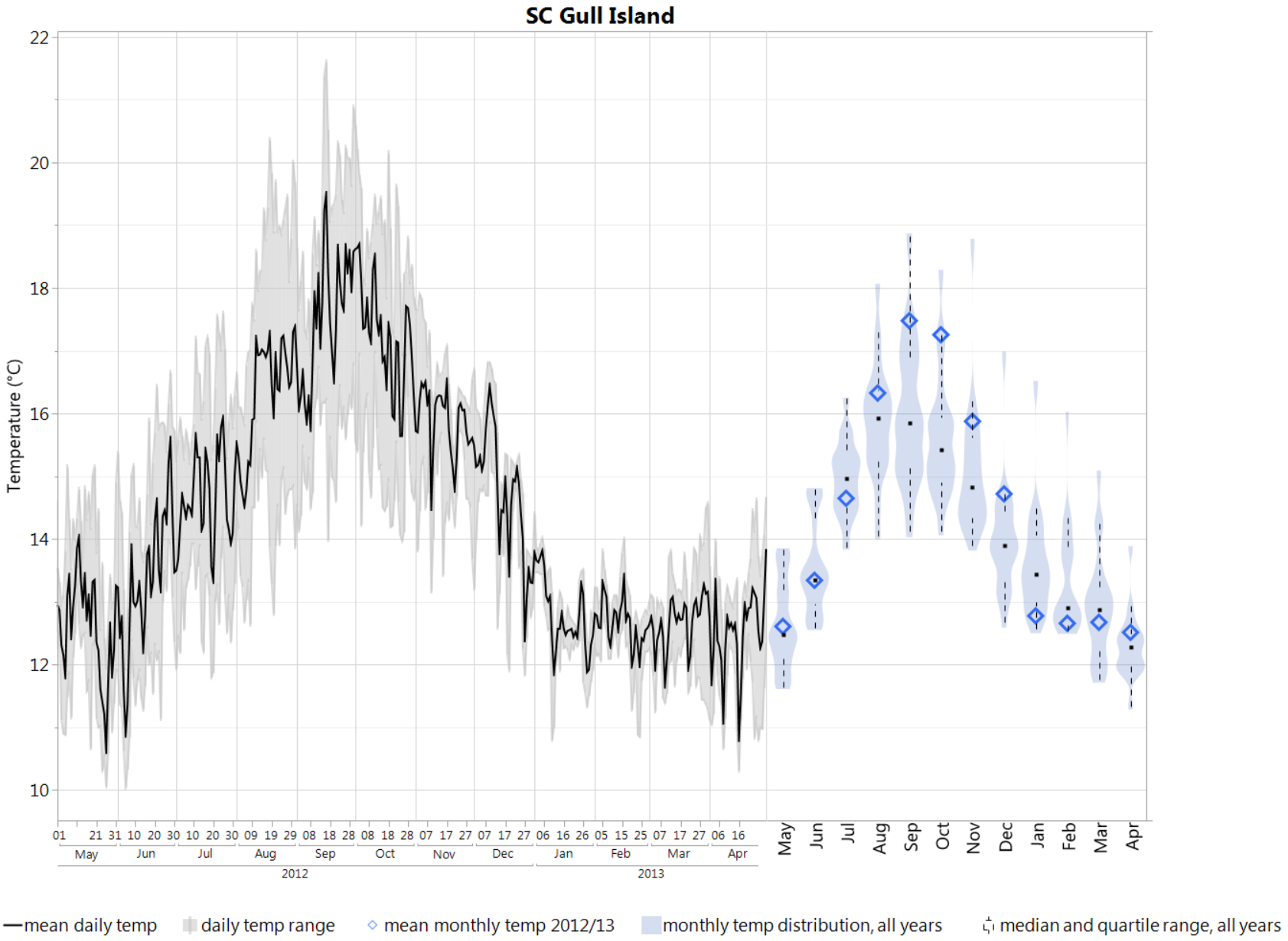

SR Chickasaw
Temperature (°C)
20
18
16
14
12
10
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

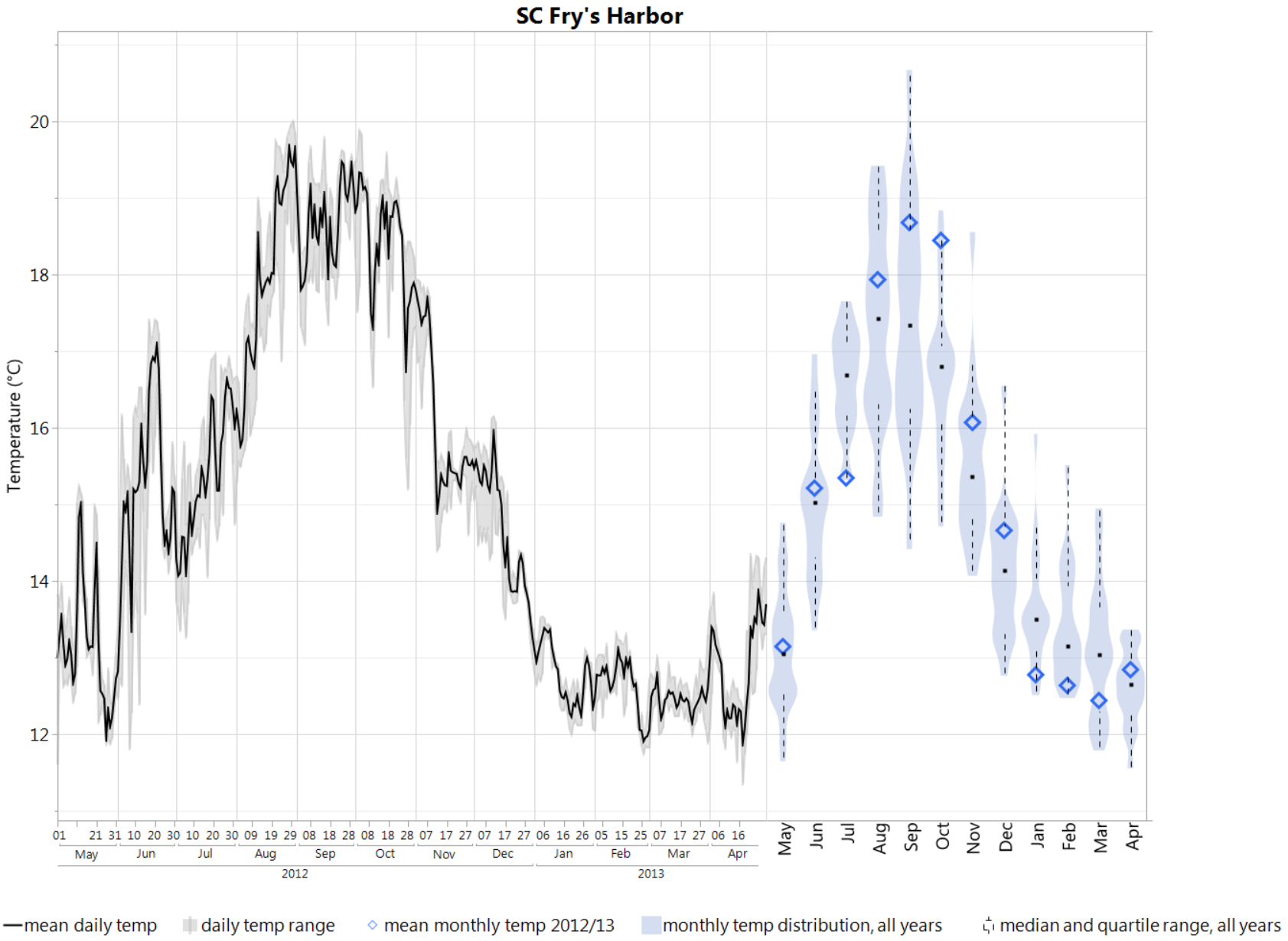

SR South Point
Temperature (°C)
20
18
16
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12
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01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

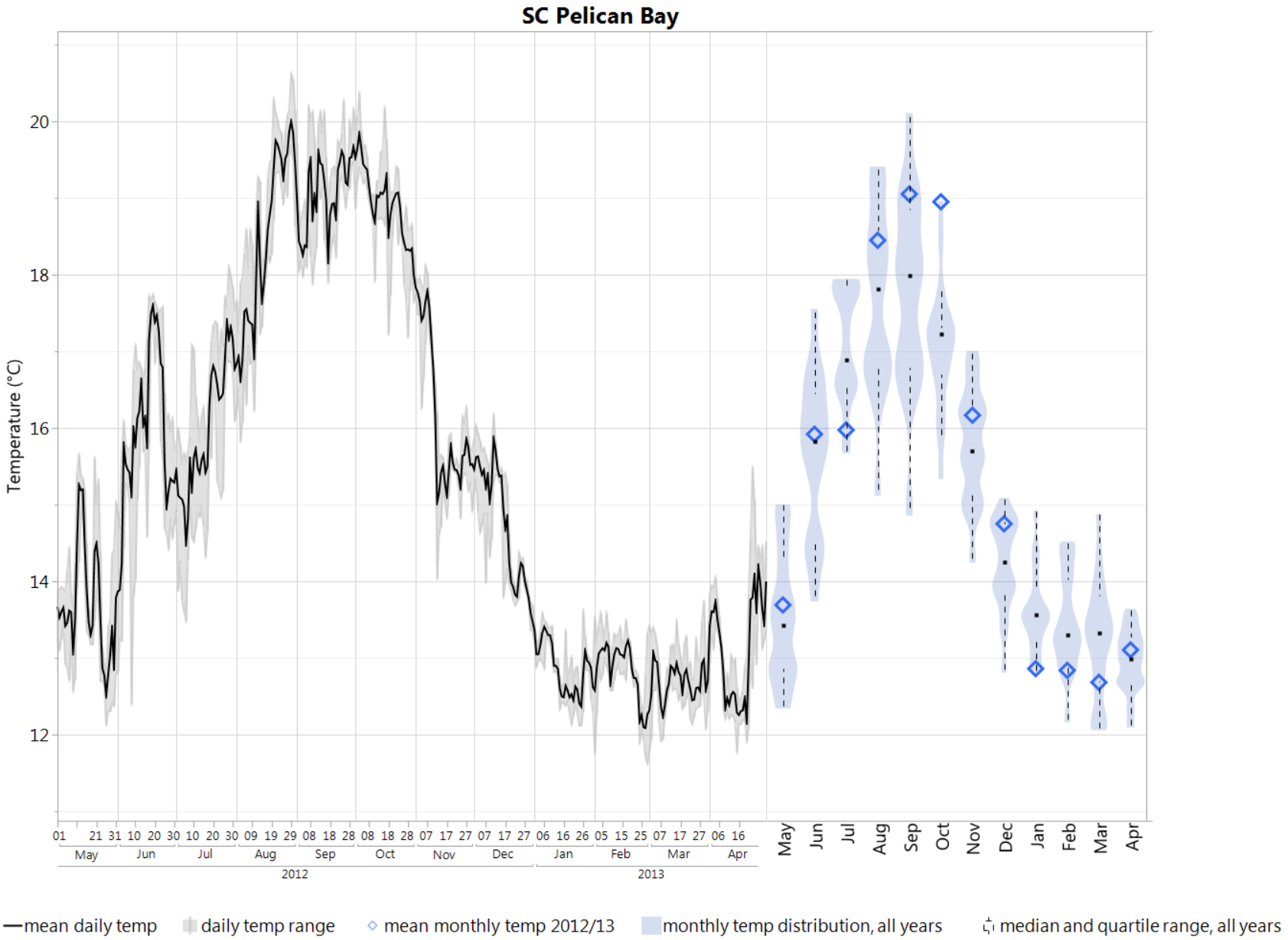

SR Rodes Reef
Temperature (°C)
18
16
14
12
10
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

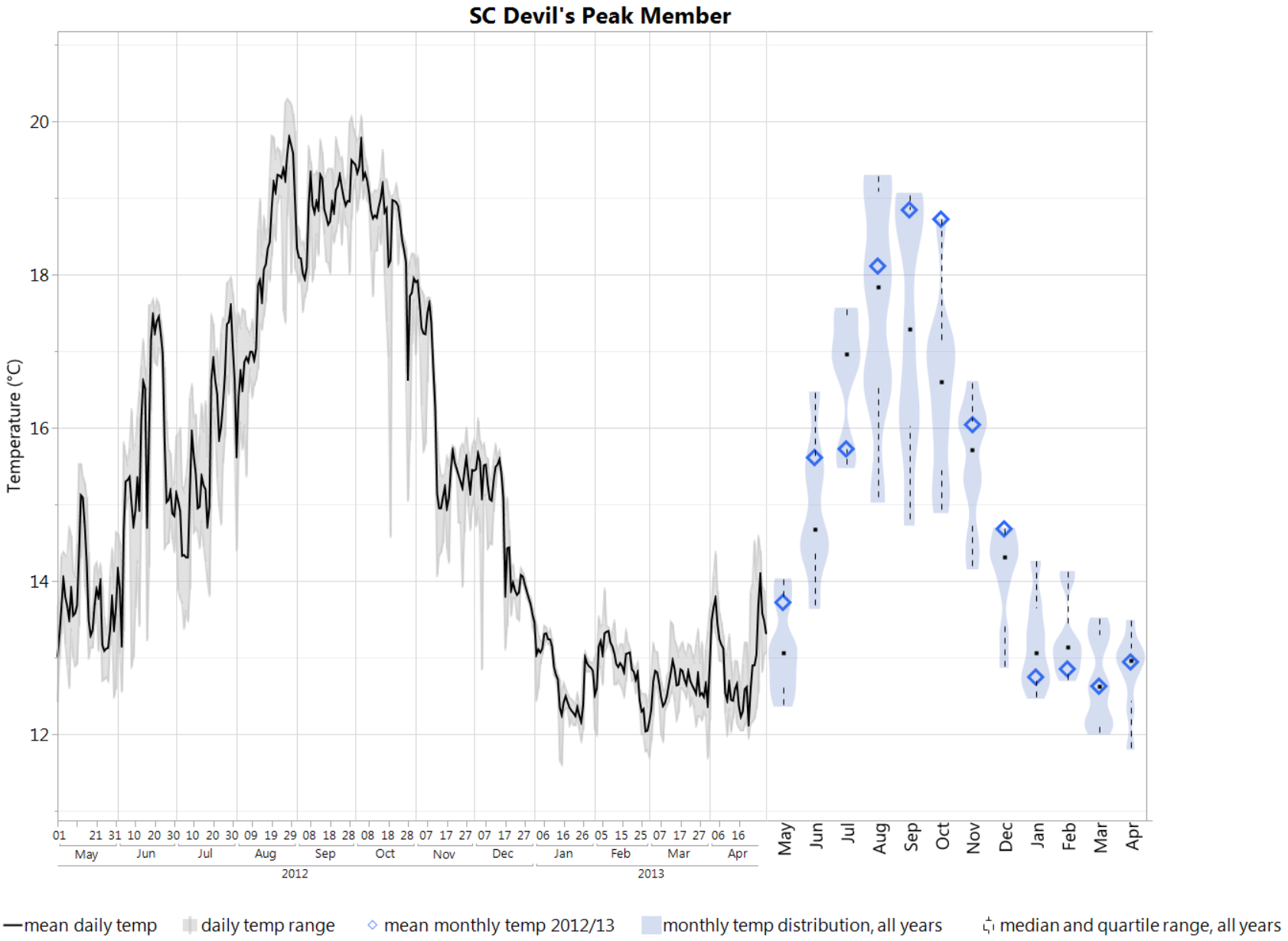

SR Johnson's Lee North
Temperature (°C)
22
20
18
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01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

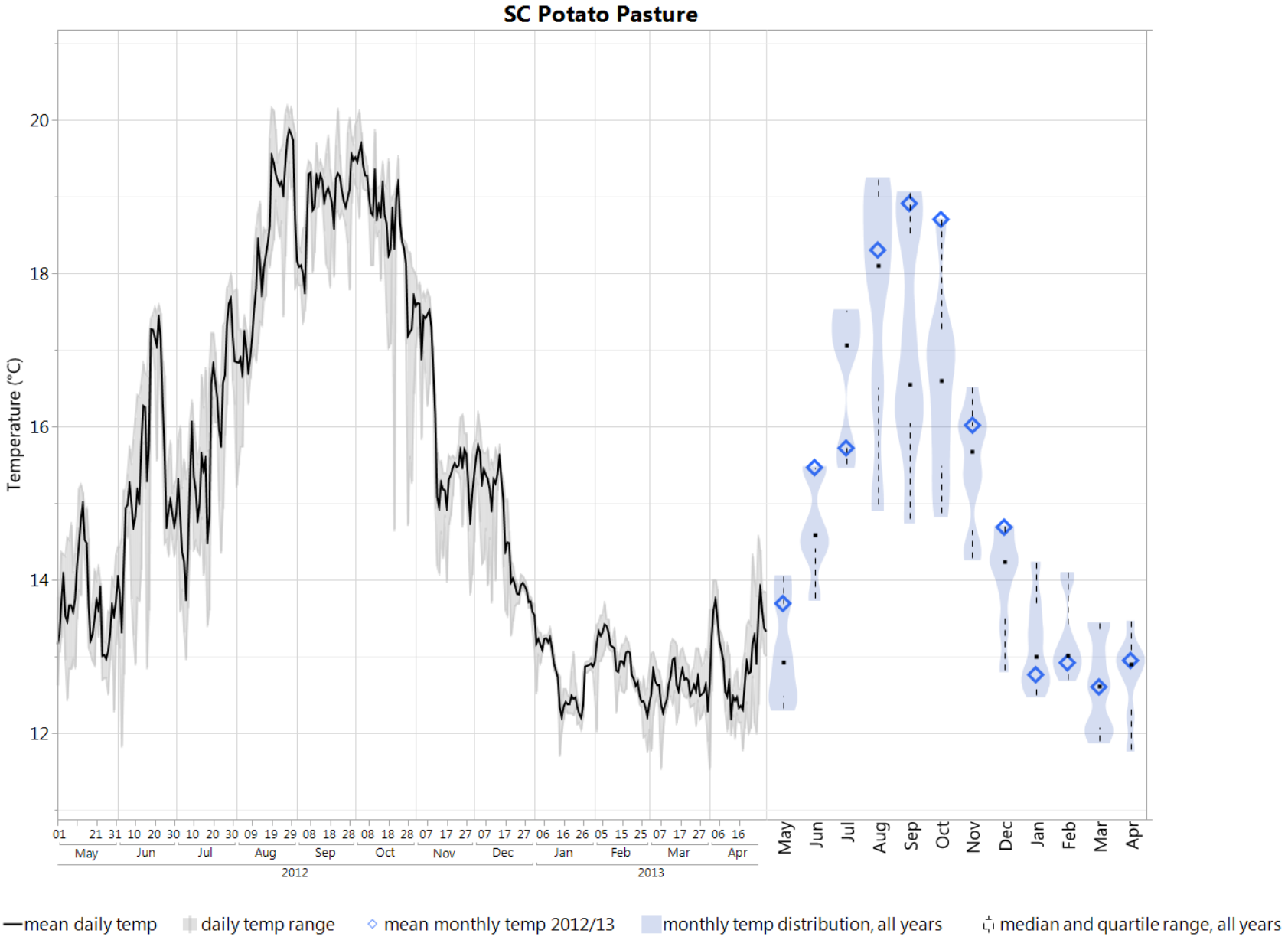

SR Johnson's Lee South
Temperature (°C)
22
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18
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01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

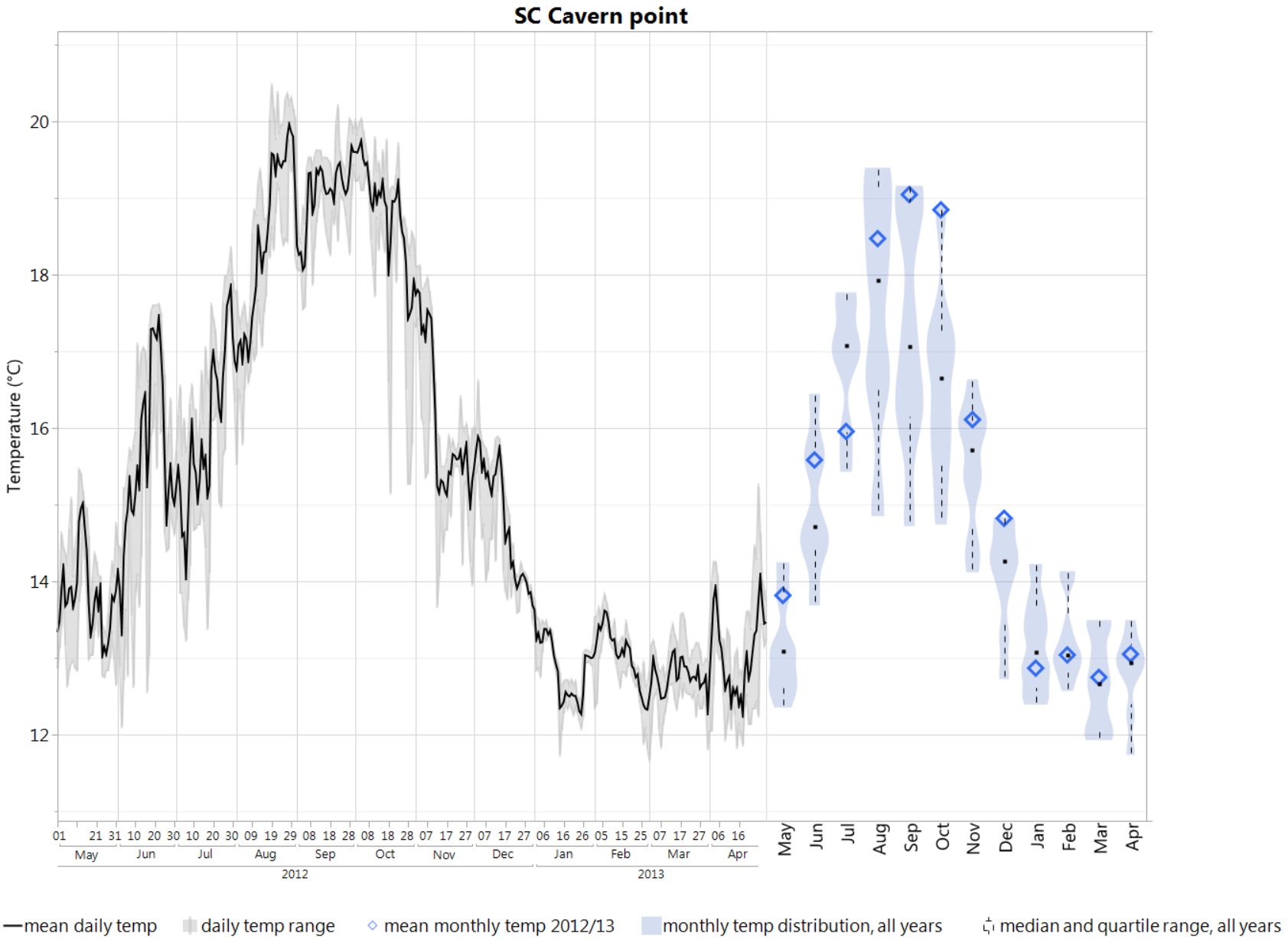

SC Gull Island
Temperature (°C)
22
20
18
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01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

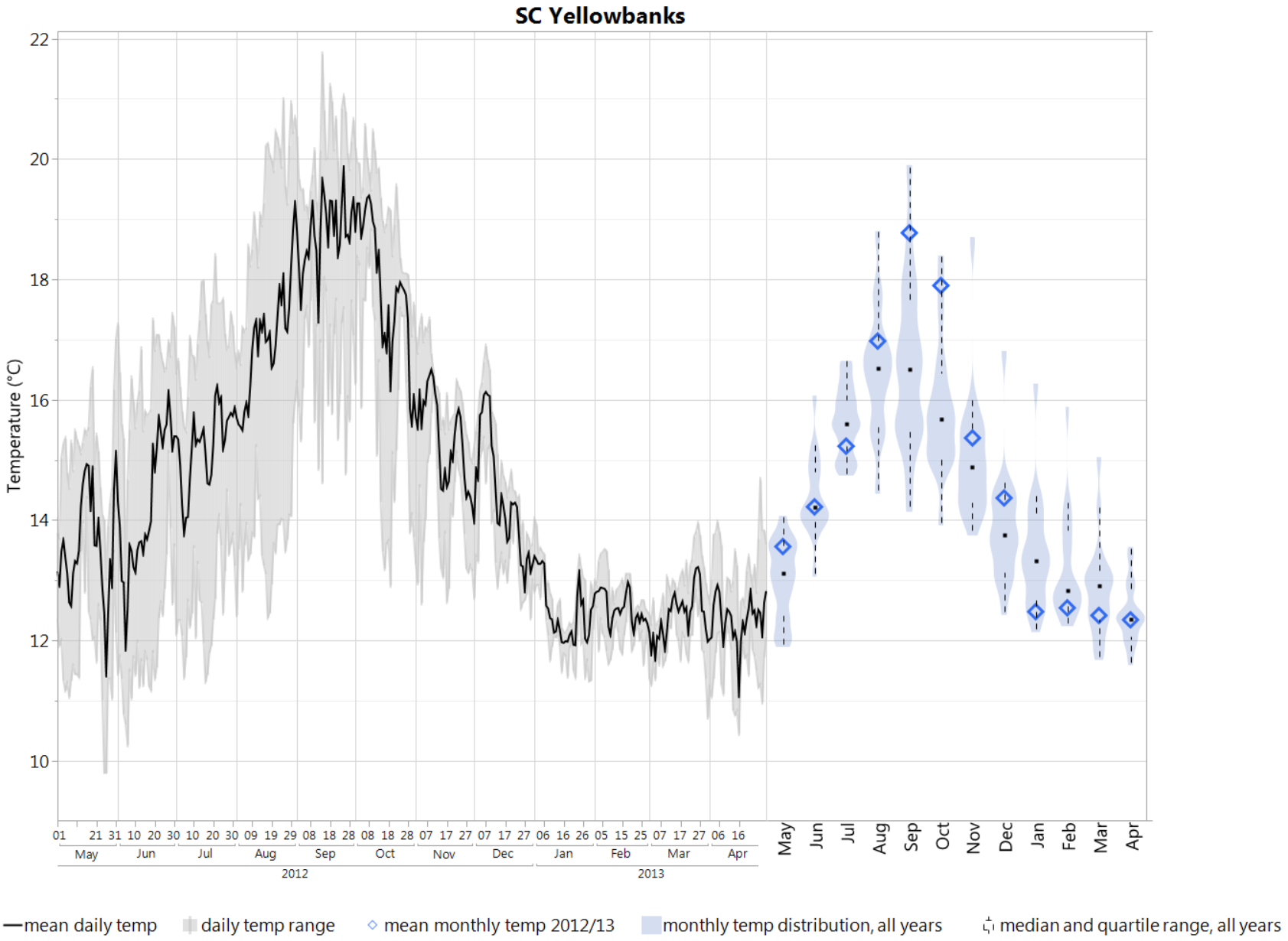

SC Fry's Harbor
Temperature (°C)
20
18
16
14
12
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

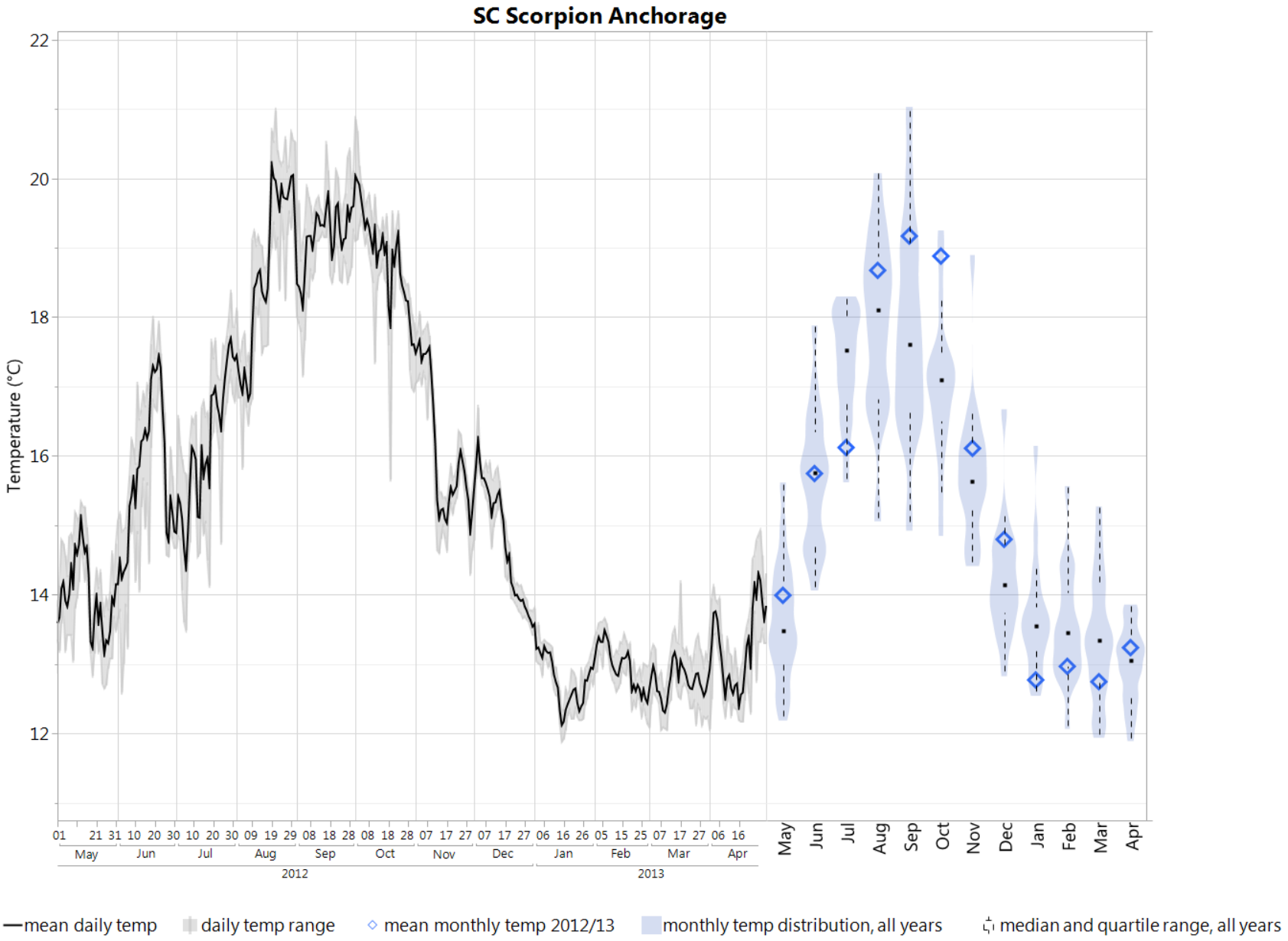

SC Pelican Bay
Temperature (°C)
20
18
16
14
12
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

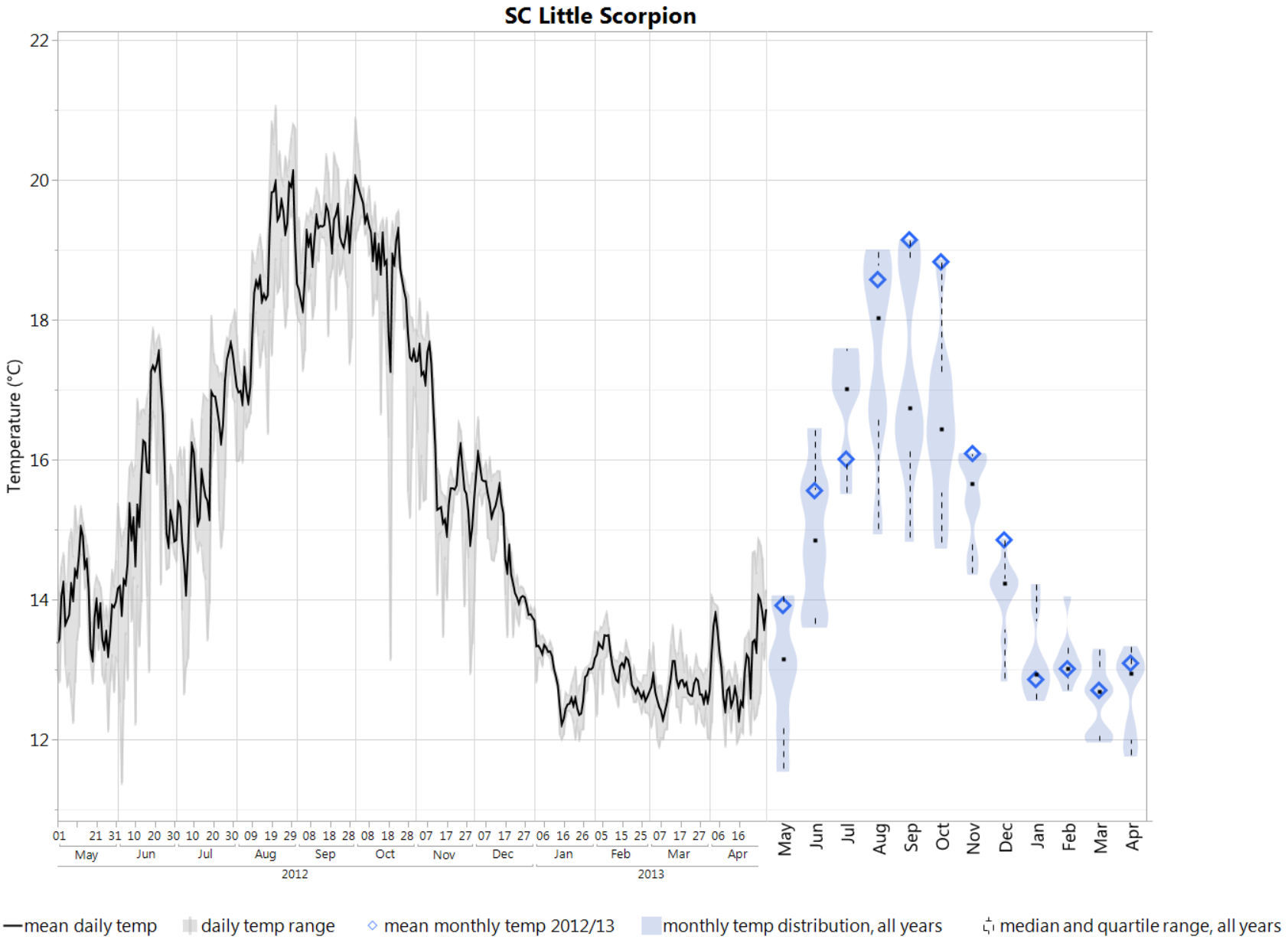

SC Devil's Peak Member
Temperature (°C)
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16
14
12
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
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mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

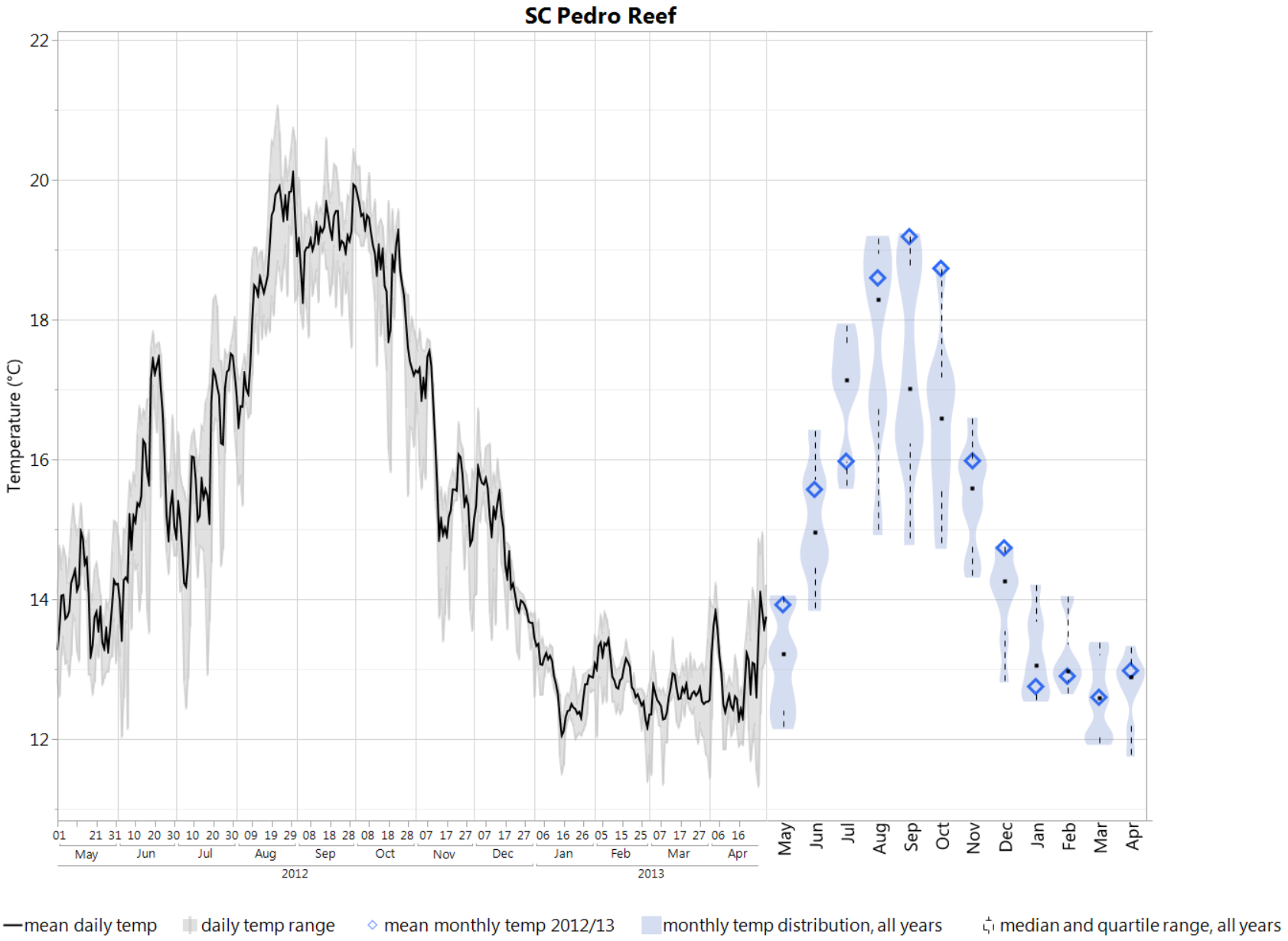

SC Potato Pasture
Temperature (°C)
20
18
16
14
12
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

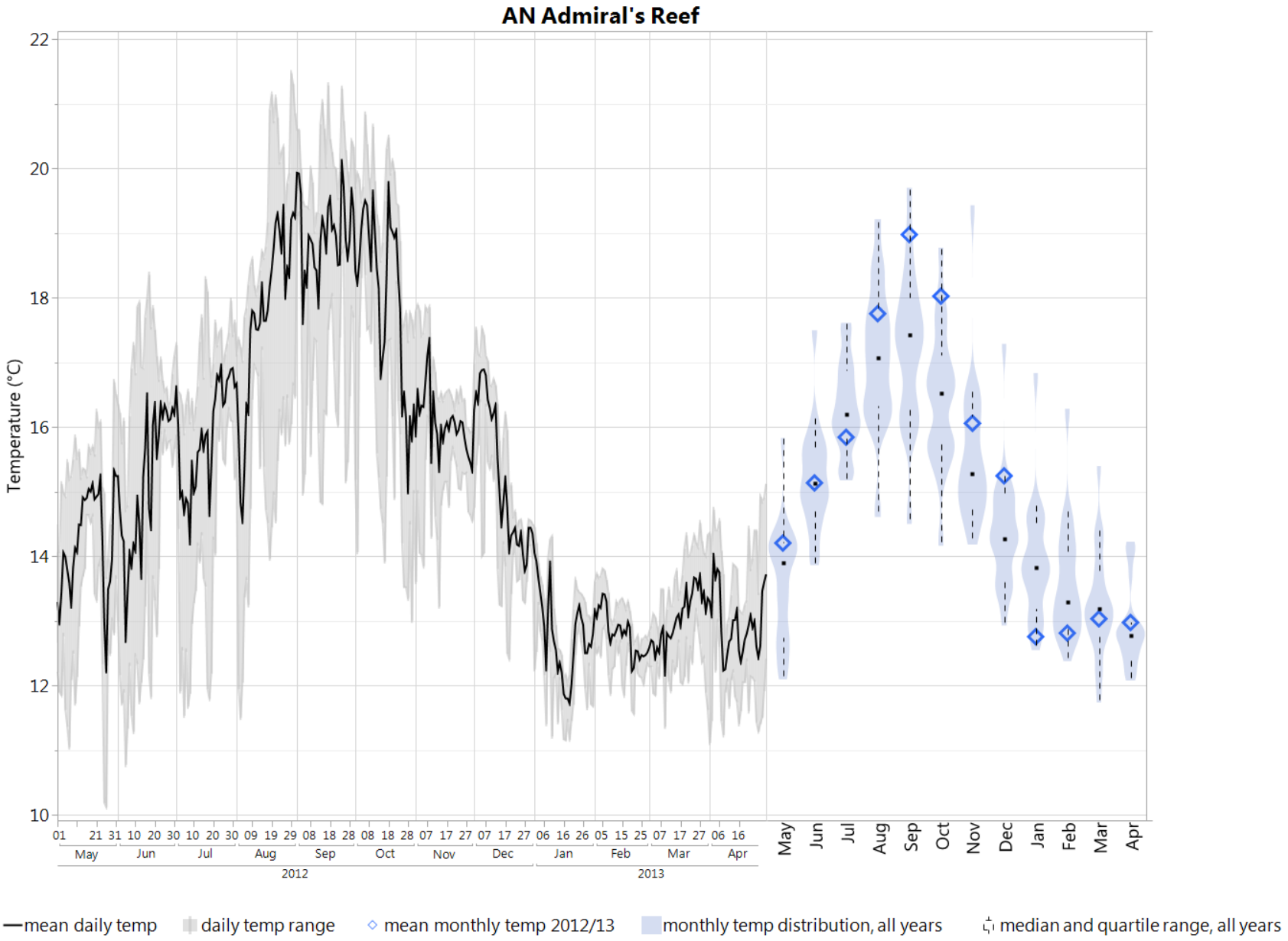

SC Cavern point
Temperature (°C)
20
18
16
14
12
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

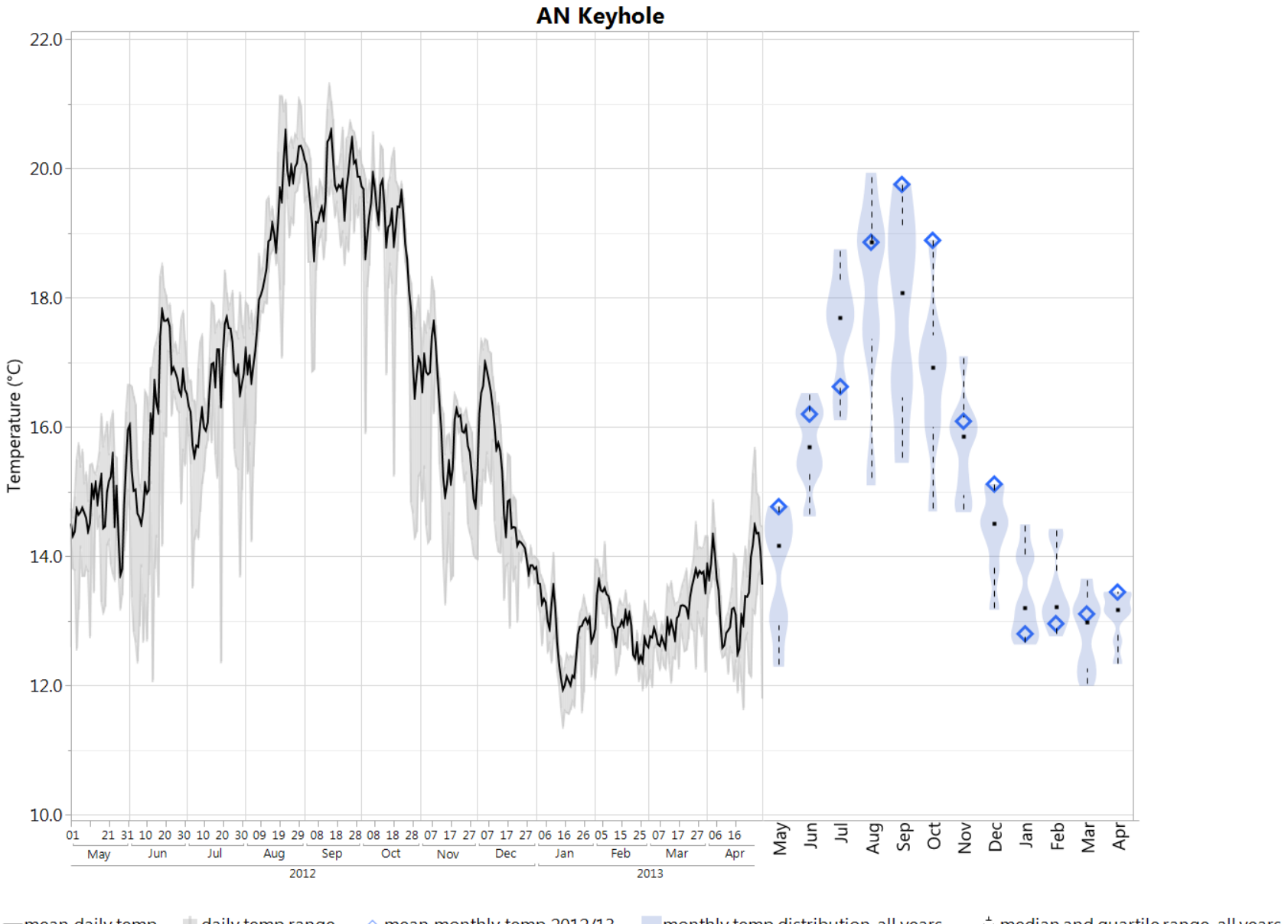

SC Yellowbanks
Temperature (°C)
22
20
18
16
14
12
10
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

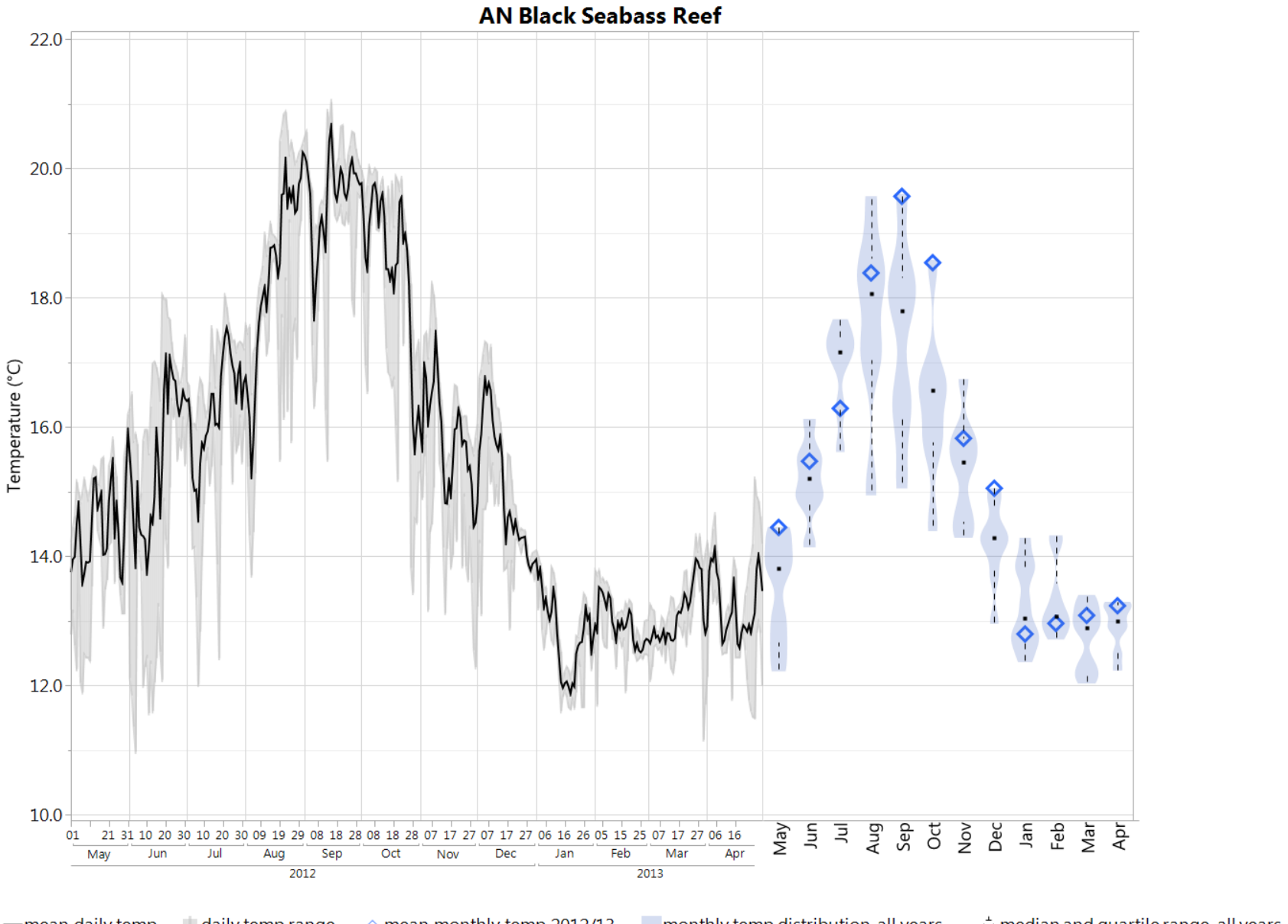

SC Scorpion Anchorage
Temperature (°C)
22
20
18
16
14
12
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

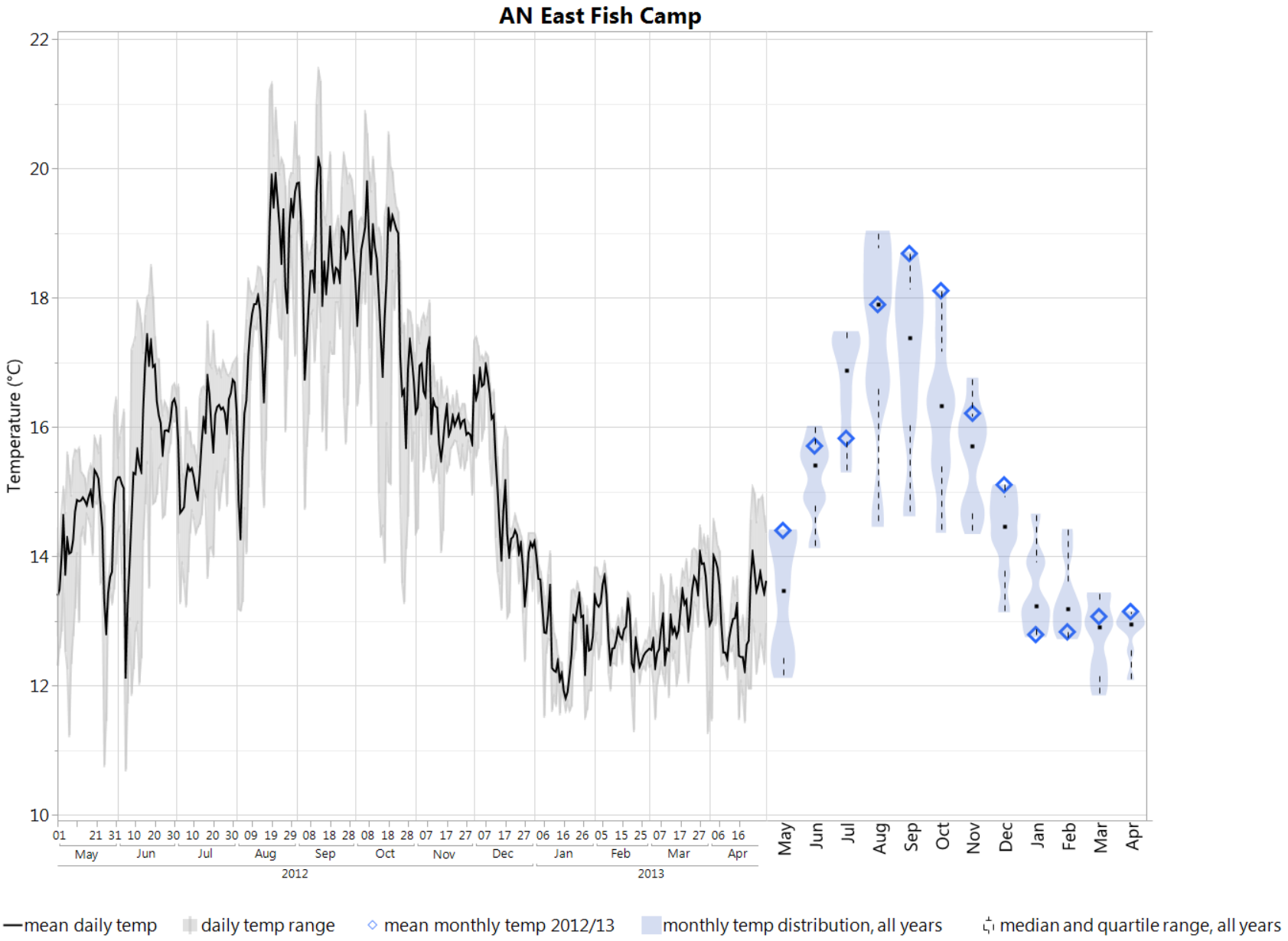

SC Little Scorpion
Temperature (°C)
22
20
18
16
14
12
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

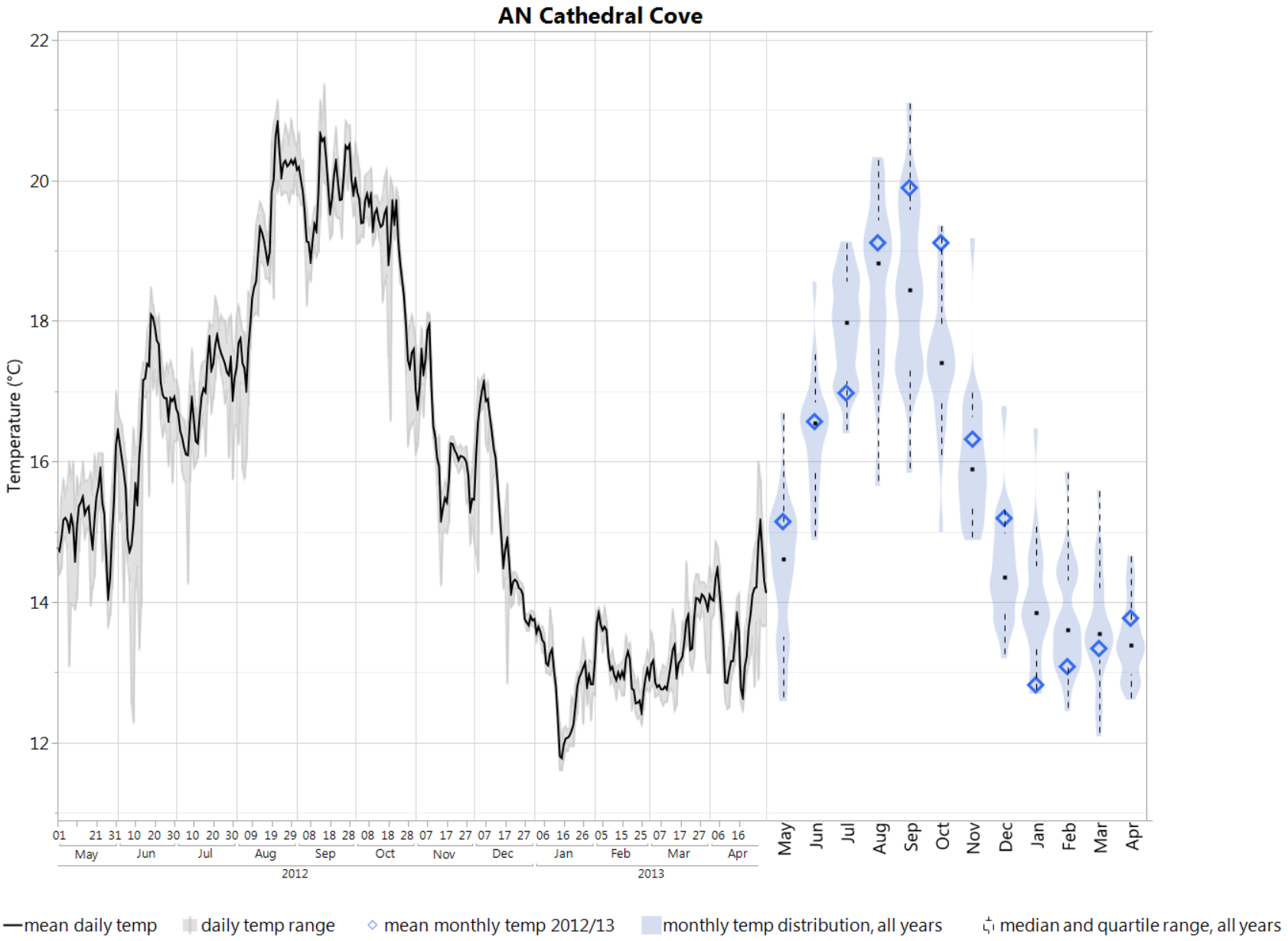

SC Pedro Reef
Temperature (°C)
22
20
18
16
14
12
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

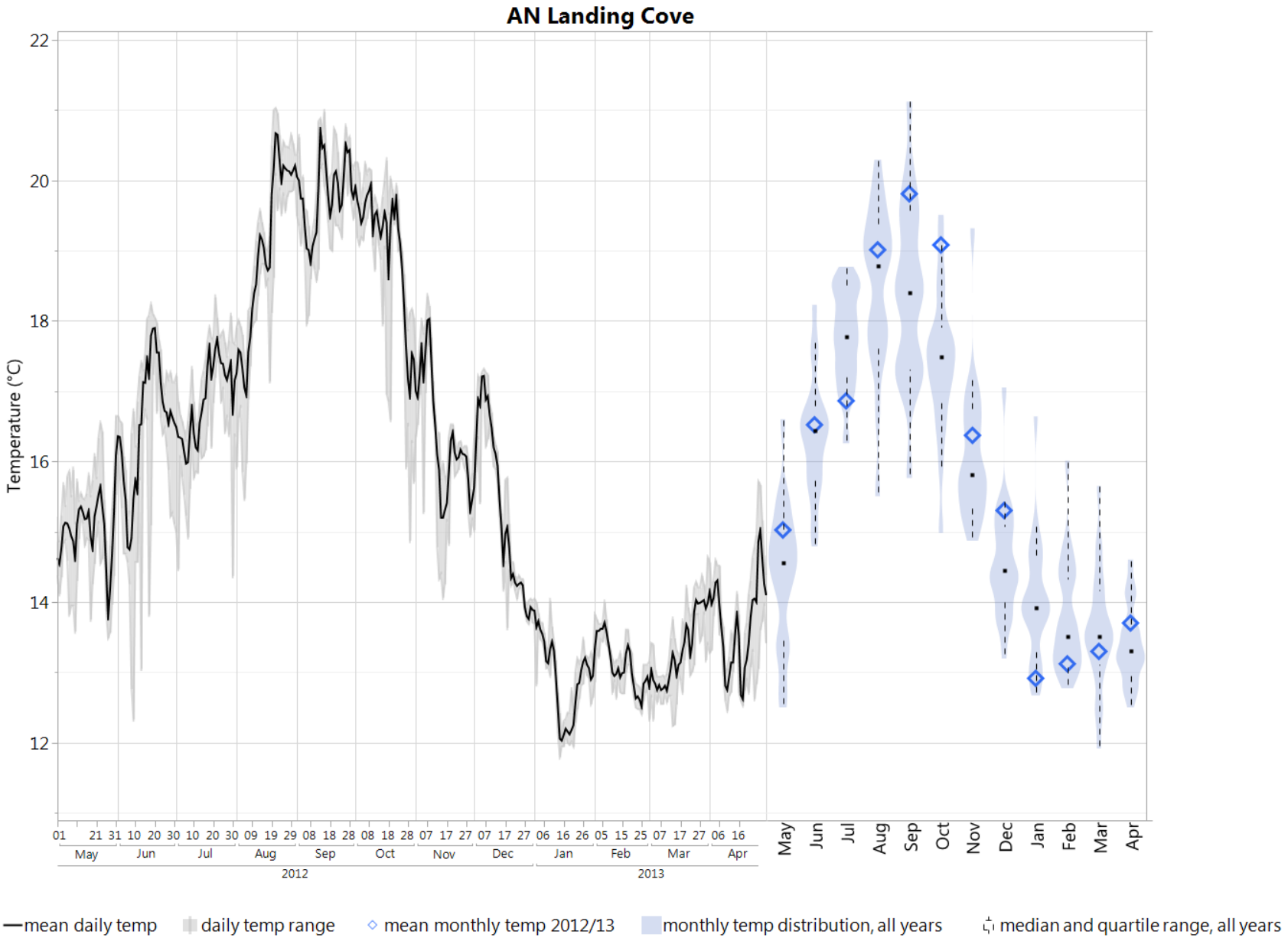

AN Admiral's Reef
Temperature (°C)
22
20
18
16
14
12
10
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

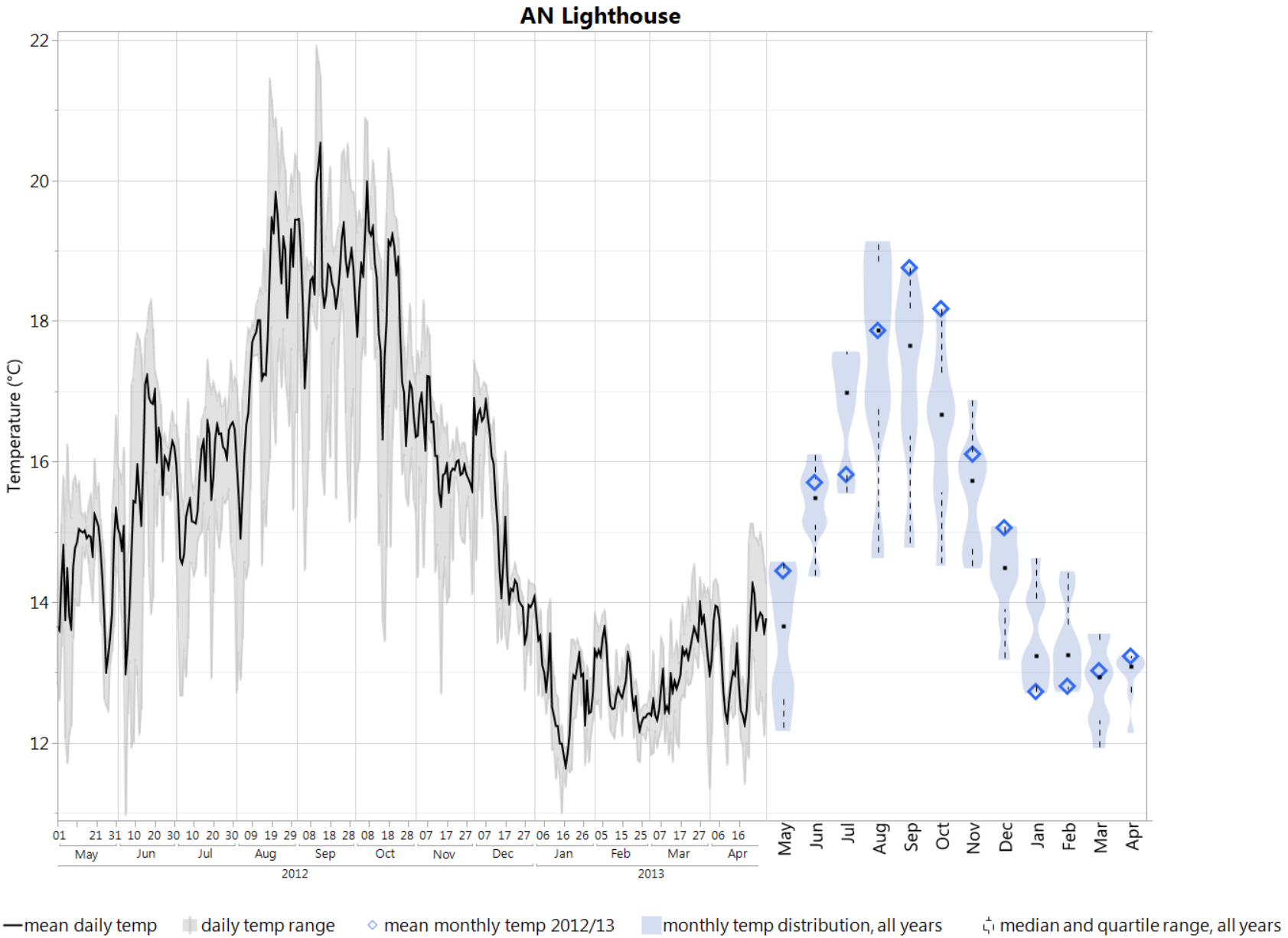

AN Keyhole
22.0
20.0
18.0
16.0
14.0
12.0
10.0
Temperature (°C)
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

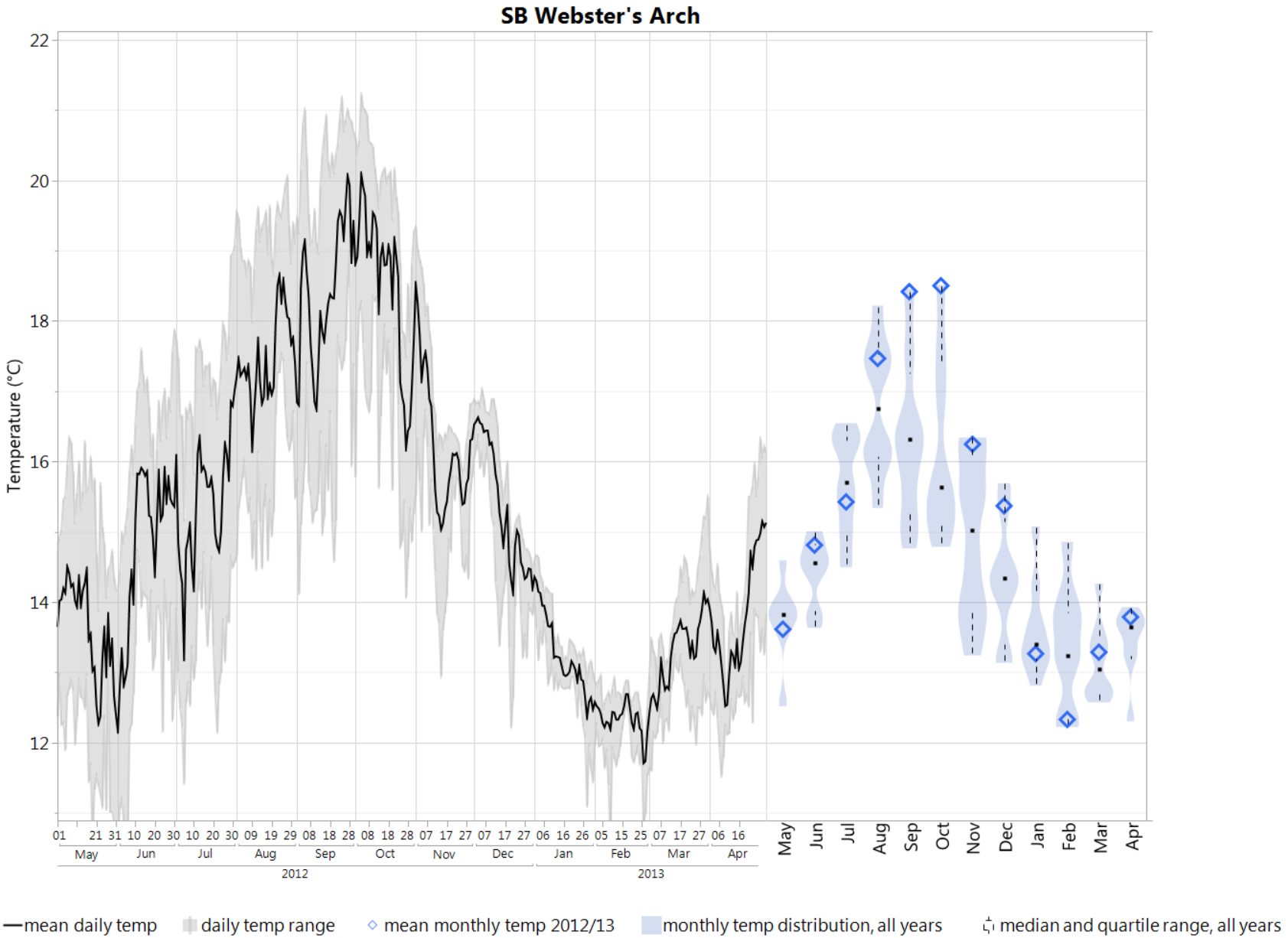

AN Black Seabass Reef
Temperature (°C)
22.0
20.0
18.0
16.0
14.0
12.0
10.0
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

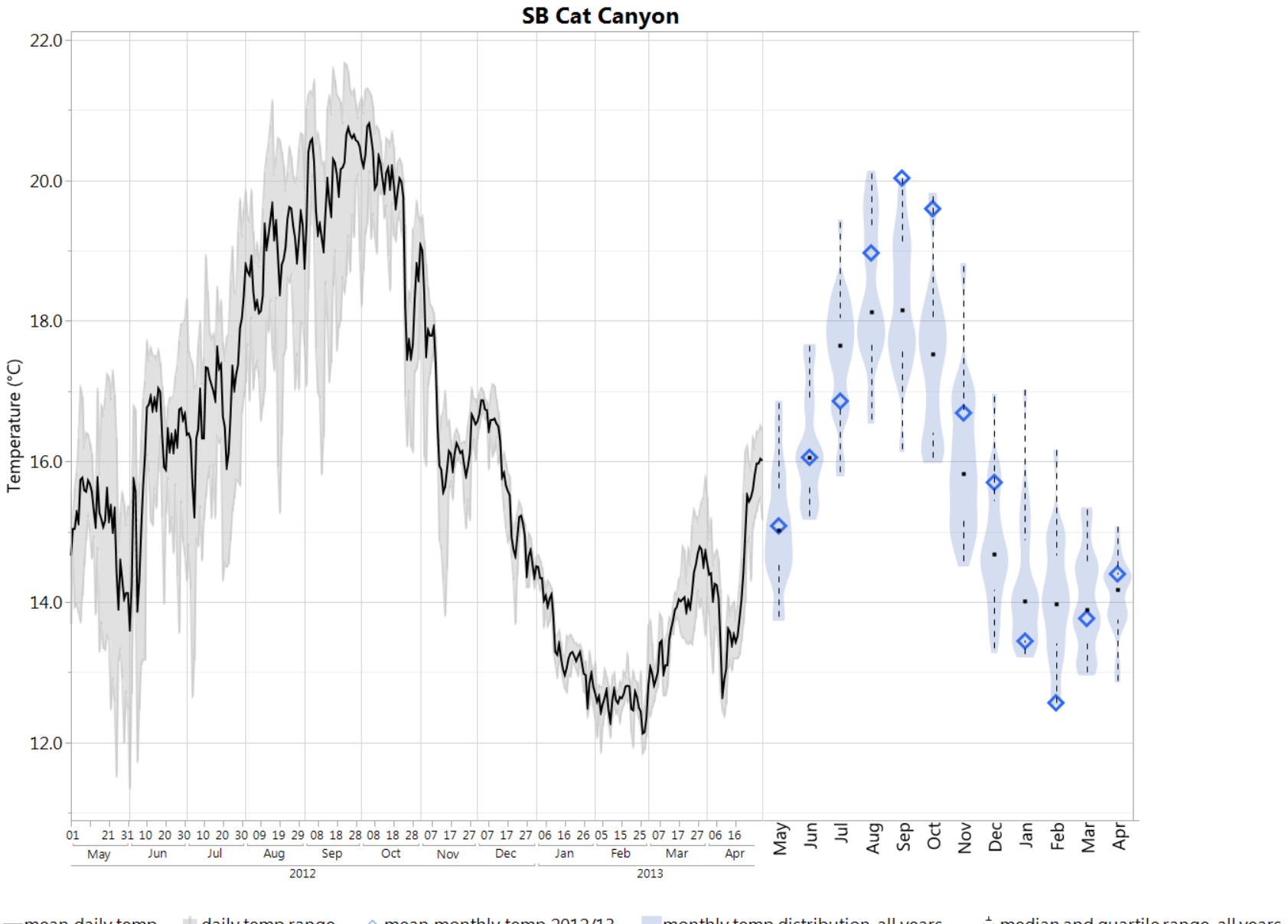

AN East Fish Camp
Temperature (°C)
22
20
18
16
14
12
10
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

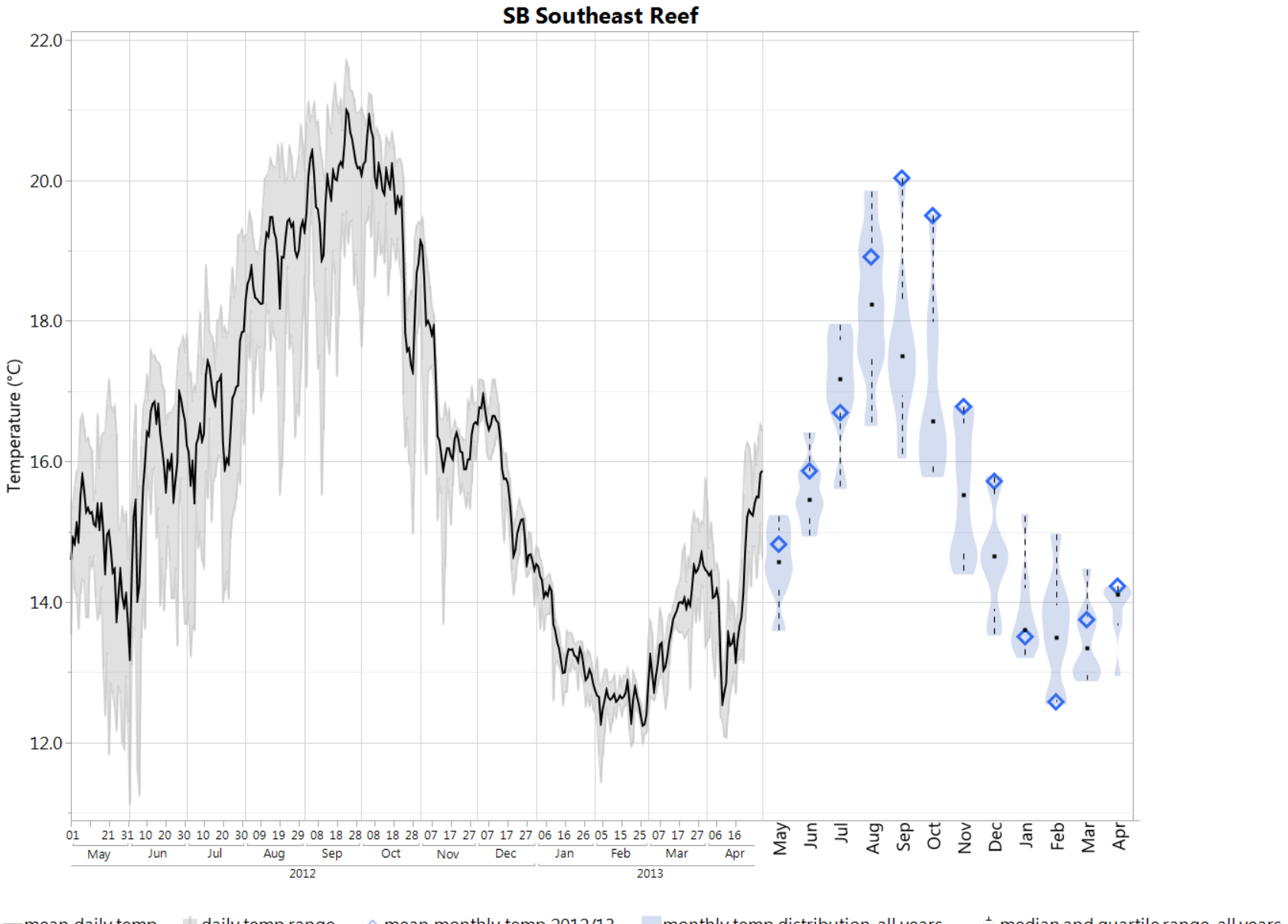

AN Cathedral Cove
Temperature (°C)
22
20
18
16
14
12
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

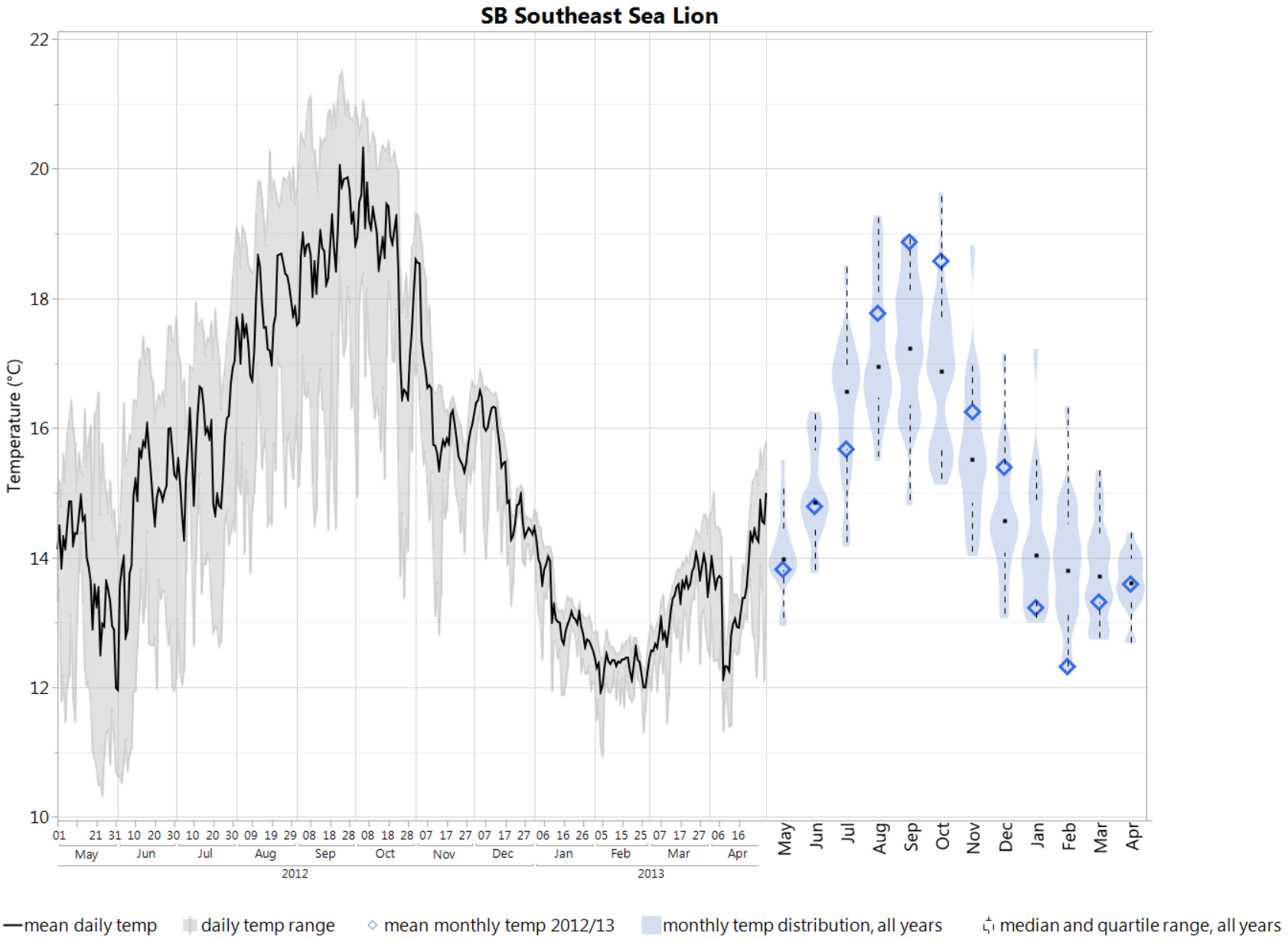

AN Landing Cove
Temperature (°C)
22
20
18
16
14
12
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

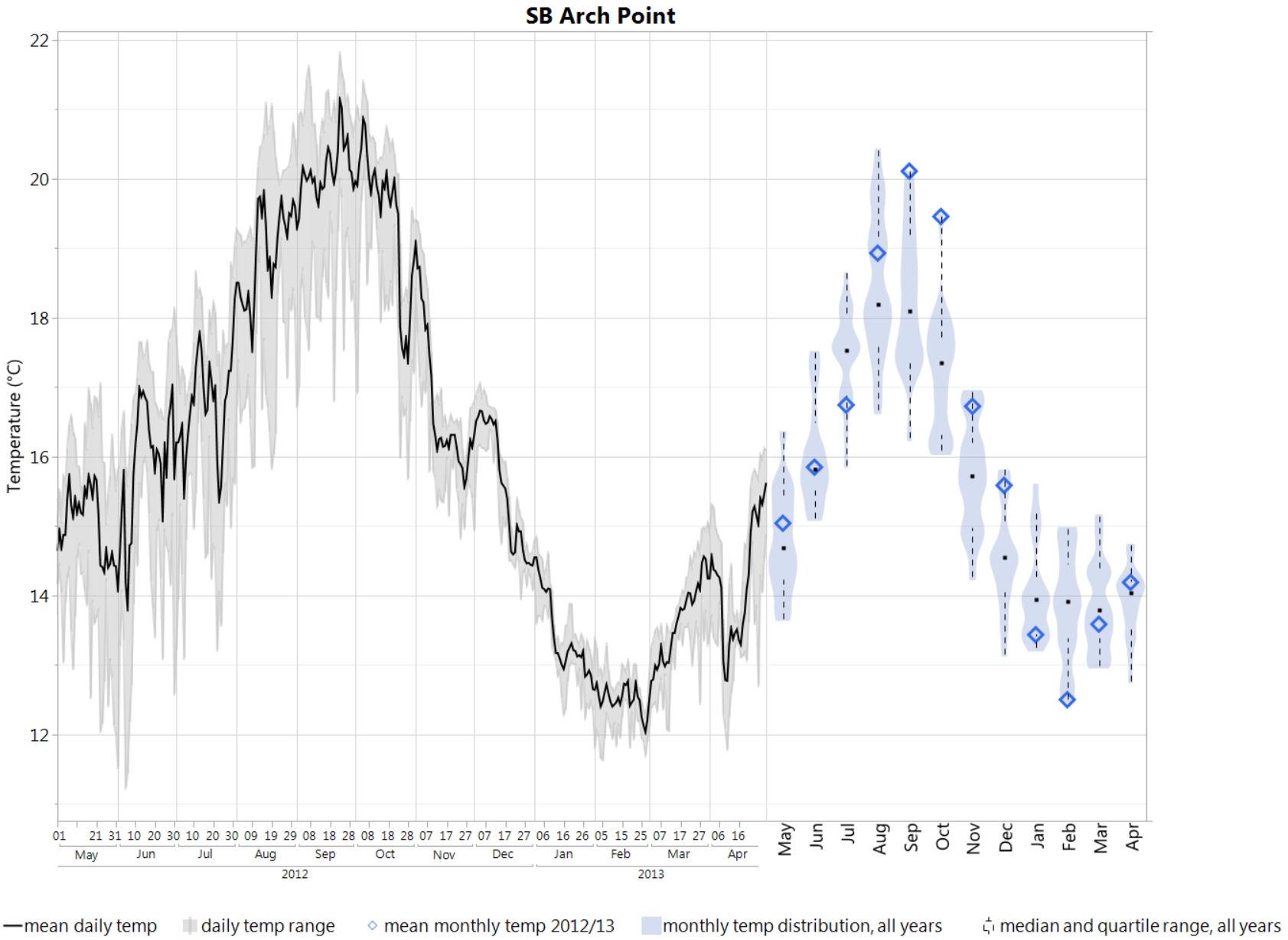

AN Lighthouse
Temperature (°C)
22
20
18
16
14
12
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

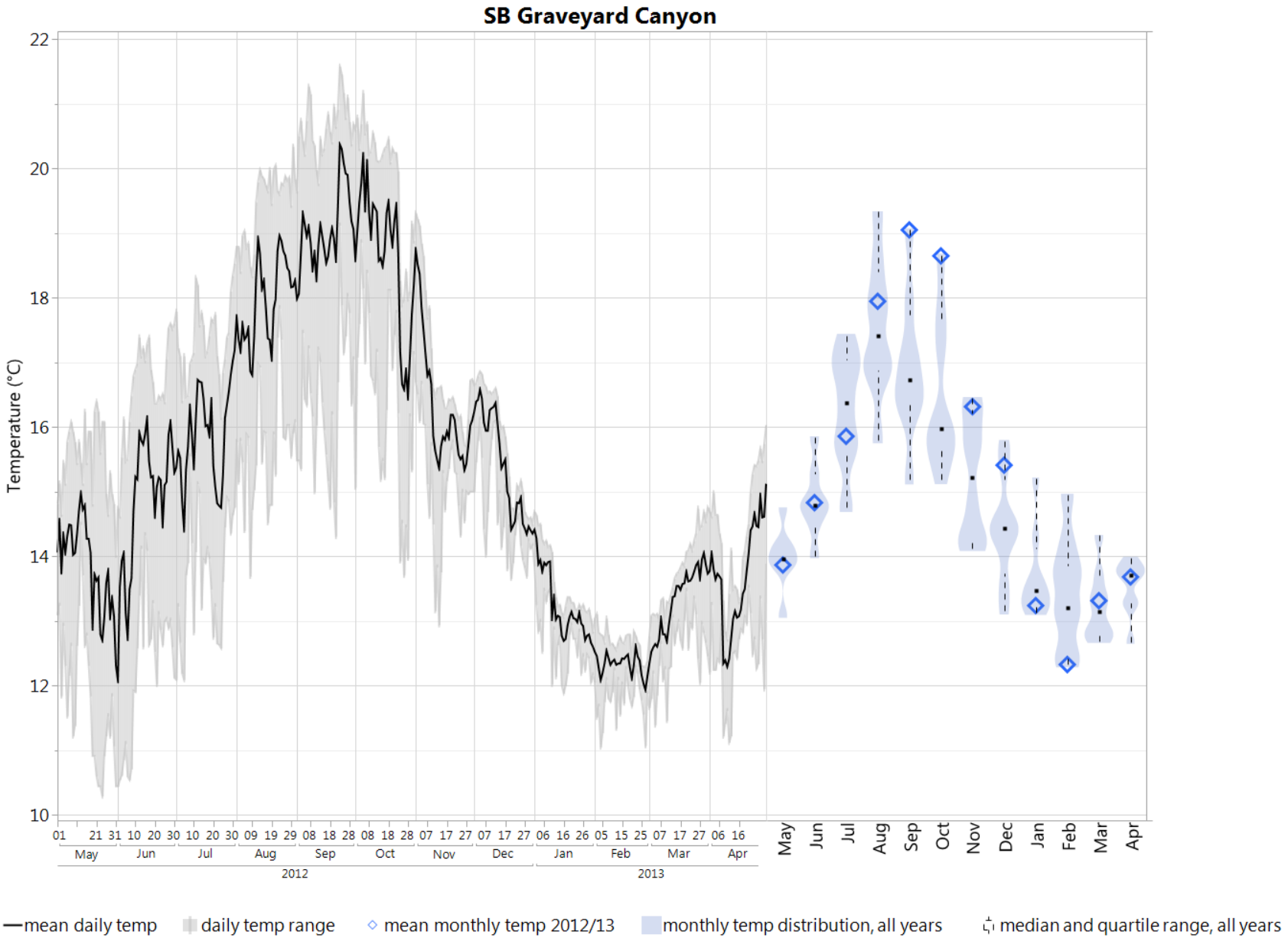

SB Webster's Arch
Temperature (°C)
22
20
18
16
14
12
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years


SB Cat Canyon
Temperature (°C)
22.0
20.0
18.0
16.0
14.0
12.0
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years


SB Southeast Reef
Temperature (°C)
22.0
20.0
18.0
16.0
14.0
12.0
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years


SB Southeast Sea Lion
Temperature (°C)
22
20
18
16
14
12
10
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years


SB Arch Point
Temperature (°C)
22
20
18
16
14
12
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years


SB Graveyard Canyon
Temperature (°C)
22
20
18
16
14
12
10
01 21 31 10 20 30 10 20 30 09 19 29 08 18 28 08 18 28 07 17 27 07 17 27 06 16 26 05 15 25 07 17 27 06 16
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
2012
2013
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr
mean daily temp
daily temp range
mean monthly temp 2012/13
monthly temp distribution, all years
median and quartile range, all years

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 159/170674, June 2020



Natural Resource Stewardship and Science
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