Final Report

Beach Watch Baseline Analysis of Birds, Mammals, and Human Use in the North Central Coast Baseline Monitoring of Marine Protected Areas

In Support of the North Central Coast Baseline
Characterization Project

Beach Watch Final Report

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1.0 Introduction: Beach Watch North Central Coast MPA Baseline Report

The 1999 Marine Life Protection Act (MLPA) directed the state of California to design a comprehensive network of Marine Protected Areas (MPAs) to protect, sustain and conserve marine life populations and increase health, productivity and resilience of ocean ecosystems. The MLPA requires monitoring of MPAs to facilitate adaptive management of these areas and ensure that the MPA network meets the goals of the Act. The North Central Coast (NCC) Marine Protected Areas Baseline Program is a collaborative effort among the State Coastal Conservancy, Ocean Protection Council (OPC), California Department of Fish and Wildlife (DFW), California Ocean Science Trust, MPA Monitoring Enterprise and California Sea Grant. "The program seeks to provide a summary description, assessment and understanding of ecological and socioeconomic conditions, inside and outside NCC MPAs to be designated under the Marine Life Protection Act, at or near the time of MPA implementation" (NCC MPA Monitoring Plan, 2010). The North Central Coast MPA region consist of 25 MPAs and 6 special closure areas comprised of approximately 153 square miles (20.1%) of state waters within the region.

In this baseline assessment for the MPA, we use the Beach Watch monitoring data, collected by citizen-scientists. Created in 1993, Beach Watch is a public-private partnership of the Gulf of the Farallones National Marine Sanctuary (GFNMS) and the Farallones Marine Sanctuary Association (FMSA), developed to study and protect the shoreline of GFNMS and northern portion of Monterey Bay National Marine Sanctuary.

Beach Watch is an award-winning project providing information to sanctuary management on species that are most vulnerable to oil pollution and disturbance, and serves as a model for other volunteer, citizen science programs. For every federal dollar spent on operating Beach Watch, two dollars are contributed to the project through fundraising by FMSA and the volunteer in-kind work force, thus making Beach Watch a cost-effective monitoring program. Since 1993, more than 300 volunteers have been trained to collect Beach Watch data through extensive 80-hour training. Volunteer retention rates for this project are virtually unprecedented. As of 2013, 75% of the volunteer pool has been with the program over 10 years and 10% of the volunteer pool will celebrate 20 years with the program.

Volunteers within the program become the "go-to" expert for "their beach" and display a high level of commitment, dedication and knowledge of the region. That knowledge is passed on to the community in the form of volunteers conducting informal outreach with curious beachgoers. Education of Beach Watch volunteers is ongoing as GFNMS and FMSA provide continuing education through seasonal wildlife identification classes and training on chain of custody, violation reporting and photo-documentation. Beach Watch staff review all records for quality control and provide periodic training and counseling to volunteers in need of improvement. It is stressed that volunteers must be 100% accurate in their identification and that precise identification to family or order is preferred when identification to species is uncertain. Volunteers are also trained in the collection of evidence for potential violations against sanctuary regulations. Beach Watch volunteers are used as local experts on the status of wildlife on a beach and are often called upon to assist during oil spill and boat grounding response efforts, thus supplementing personnel resources knowledgeable on local conditions.

The data reviewed in this report focuses on long-term analyses of the existing Beach Watch data from 1994 through 2012 as collected from 39 beaches within the Northern Central Coast (NCC) region. Project goals align with two main objectives of the baseline characterization, as described in the NCC MPA Baseline Program Request for Proposals:

1. Provide initial data points and historical trend data for long-term tracking of condition and trends in North Central Coast sandy beach and rocky intertidal ecosystems; and

2. Inform long-term monitoring recommendations. Compilation and description of the Beach Watch data will contribute to the baseline assessment conditions within and nearby newly established MPAs and provides trend information for the abundance and distribution CA coastal birds, marine mammals and human activities for the North Central Coast sandy beach ecosystems.

This report summarizes the baseline levels and trends of coastal birds, marine mammals and human use activities within the State's newly established marine protected areas along the north-central coast and summarizes regional trends using i.e., reference beaches outside of the MPAs (Figure 1 and Appendix B). Baseline levels are determined as "encounter rates", number of animals or people per kilometer surveyed. Baseline levels were determined by calculating the cumulative encounter rates for each beach, for 256 birds, 25 of marine mammals, and 25 of human activities (Appendix D and E), with emphasis on 20 key species (Table 1), as prescribed by the NCC Monitoring Framework. Data collected through Beach Watch, but not presented here because it is beyond the scope of work requested by the Monitoring Enterprise, includes age and sex demographics of dead wildlife, encounter rates for oil pollution, reporting violations and stranded wildlife, relative abundance of beach wrack, beach profile photo-documentation for erosion and deposition and status of opening of the mouths of lagoons and streams.

The project will provide the following:

1. Compilation and description of existing Beach Watch data, describe methods and data collected in areas currently surveyed within the NCC MPAs.

2. Analysis of Beach Watch live and dead bird and marine mammal data to:
   a. Provide summaries and descriptions of major spatial and temporal patterns;
   b. Describe historical trends in specific species of interest identified in the North Central Coast Monitoring Framework; and
   c. Summarize description of marine mammal sightings inside and outside MPAs and across the survey region.

3. Collect, provide and summarize Beach Watch human use data inside and outside MPAs and across the survey region.

4. Provide long-term monitoring recommendations via participation in collaborative processes (e.g. workshops) with the MPA Monitoring Enterprise and other baseline program project leaders to:
   a. Contribute towards an integrated and synthesized assessment of ecosystem conditions at the time of MPA implementation and initial MPA effects following MPA implementation; and
   b. Compare data from citizen science and other monitoring methods to provide recommendations for long-term monitoring.

1.1 Overview of Beach Watch Survey Sites in the NCC Study Region

In 2010, 25 MPAs and 6 Special Closure areas were designated between Alder Creek near Point Arena in the north and Pigeon Point in the south (Appendix A) (MLPA). Included in this report are data from 39 beaches within the NCC region, as well as 3 beaches from the Central Coast region (CC). Of the 42 beaches currently surveyed through Beach Watch, 11 are within a state MPA (eight in the NCC region and three within the Central California region, see Figure 1 and Appendix B): Drakes West, Drakes East and Limantour West (partially) within Point Reyes SMR; Bolinas Beach within Duxbury Reef SMCA; four beaches at Fitzgerald Marine Reserve: Weinke Way, Entrance, Distillery and Frenchman's within Montara SMR. Three Beach Watch beaches (North Point, Cove Beach and Bradley Beach) are within the Central Coast Study Region, within the Año Nuevo SMCA and are included in this report. All other Beach Watch beaches (31) are considered by the Monitoring Enterprise to be reference sites and indicative of regional ecosystem status and trends (Figure 1 and Appendix B).
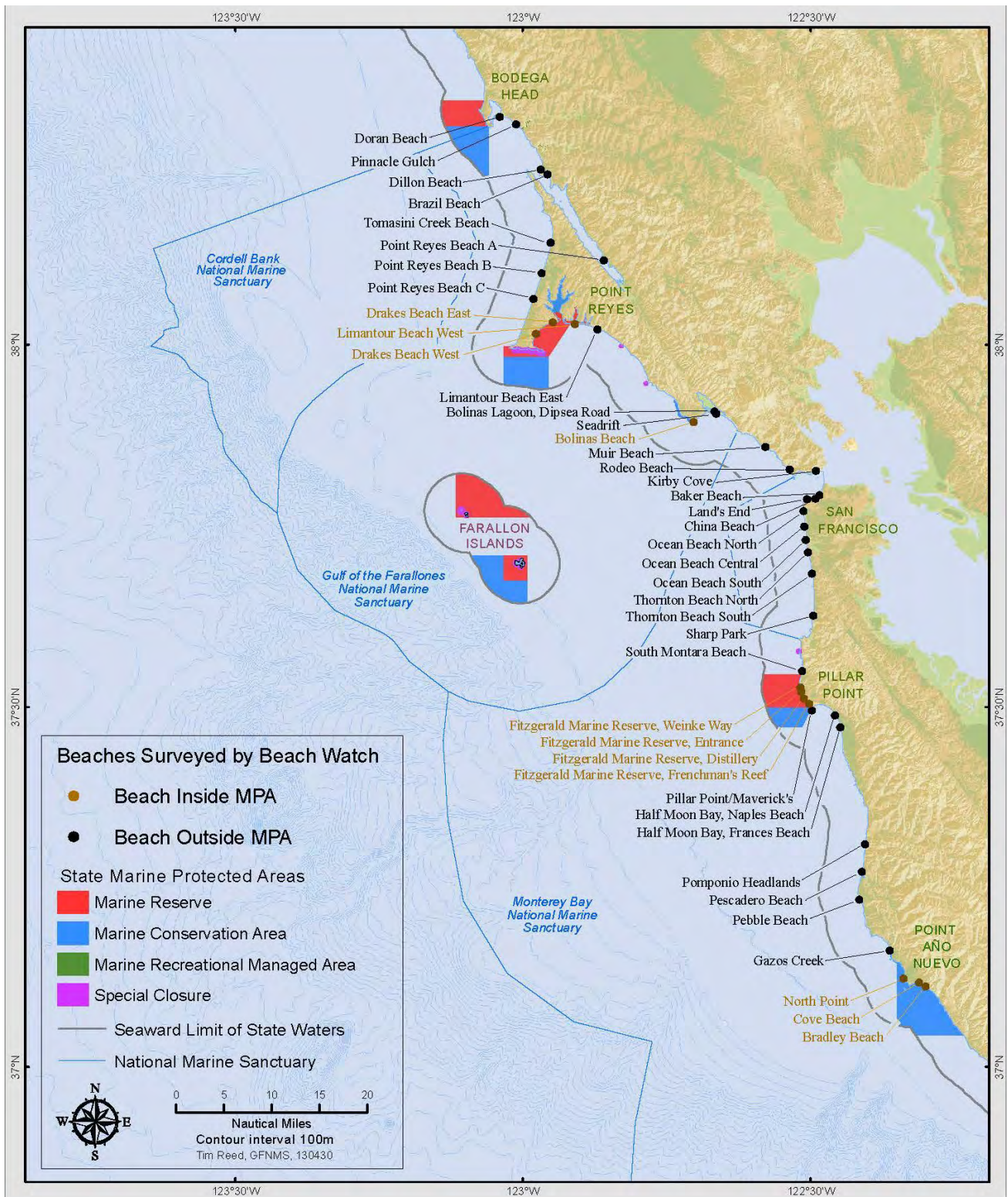
Figure 1. Beach Watch survey locations. Surveys conducted inside a state designated Marine Protected Areas are highlighted in brown dots and text. Reference beaches are those outside of MPAs and noted in black dots and text.

1.2 Methods

Description of Data Collection:
Data on live and dead coastal birds and mammals, and 20 human uses (Appendix D and E) were collected from 39 beach segments, spanning more than 240 km of coast from Bodega Head in Sonoma County south through to the San Mateo-Santa Cruz County border (Figure 1 and Appendix B). Beaches were surveyed every two weeks. Some beaches were surveyed every four weeks for periods of time due to lack of volunteers. See Appendix C for survey effort for each beach.

Beach segments were surveyed in a zigzag fashion and surveyors scanned the edges of any upper dunes. The observation area included the main body of the beach, as well as 30 m inland and offshore from the beach. Surveyors walked the length of the beach segment, documenting all observed live birds, and human uses within the zone boundaries (Appendix E), as well as all marine mammals observed (Appendices D). Surveyors then walked back the full length of the survey to locate and document each bird or mammal carcass encountered for later species verification. For each dead carcass, surveyors recorded the species, age, sex, presence of bands or tags, presence and percentage of oil, evidence of scavenging, completeness of the carcass and any evident cause of death, such as oil pollution, shark bite or entanglement in marine debris. Surveyors classified state of decomposition of dead vertebrates as fresh dead, decomposing or mummified. An expert ornithologist verified species identifications by reviewing photographs taken during surveys. Documented dead vertebrates were marked so as not to be counted in subsequent surveys. Data sheets are provided in Appendix I. Data in this report include only counts of live and dead vertebrates by species or familial taxon and counts of human activities.

Surveyor Training Standards
All surveyors were required to attend an 80-hour training program in protocols, species identification, data entry and sample collection before collecting field data. Training included 13 class lectures led by Beach Watch staff and other field experts, three full field days focused on bird and mammal identification, and three practice surveys. During the post-training period, Beach Watch staff closely monitored and mentored surveyors in the field to assure data was collected according to standardized protocols, accurately and with as much precision as possible. Continuing education was ongoing with field identification of live and dead coastal birds and marine mammals, presentations highlighting sanctuary ecosystem processes, status and trends of coal birds and mammals, and management actions.

Description of Analyses
The data presented here were based on a total of 14,443 surveys, representing 59,788 km of effort (Appendix C), collected from January 1994 through December 2012. In order to account for variation in survey effort; bird, mammal and human activity data were quantified as encounter rates, i.e., the number of animals or human activity per kilometer surveyed. All observed species were used for broader vertebrate category analysis (Appendix F1-F6). Species specific analysis was limited to 20 species of interest, 18 identified in the NCC Monitoring Framework, and 2 additional common species resident to the region, Western Gull and California sea lion (Table 1, Figures 16-48).

Table 1. Species of specific interest as listed in the North Central Coast Monitoring Plan (2010). Species included in species specific analysis. Resident breeding species are in bold. Additional species included as potential indicators species within the same guild or foraging complex ecosystem are noted with asterisk.

Western/Clark's Grebe	*Aechmophorus occidentalis, clarkii*
Brandt's Cormorant	*Phalacrocorax penicillatus*
Double-crested Cormorant	*Phalacrocorax auritus*
Pelagic Cormorant	*Phalacrocorax pelagicus*
Brant	*Branta bernicla*
Surf Scoter	*Melanitta perspicillata*
Snowy Plover	*Charadrius alexandrinus*
Black Oystercatcher	*Haematopus bachmani*
Willet	*Catoptrophorus semipalmatus*
Surfbird	*Aphriza virgata*
Western Sandpiper	*Calidrius mauri*
Western Gull*	*Larus occidentalis*
Common Murre	*Uria aalge*
Pigeon Guillemot	*Cepphus columba*
Marbled Murrelet	*Brachyramphus marmoratus*
Harbor Porpoise	*Phocoena phocena*
Southern Sea Otter	*Enhydra lutris*
Steller Sea Lion	*Eumetopias jubatus*
California Sea Lion*	*Zalophus californianus*
Harbor Seal	*Phoca vitulina*

Trend analyses were based on data from 33 beaches in which at least one survey was performed in each of the 18 years 1995 through 2012. Encounter rates for 11,058 live surveys (24,477.58 km) and 11,053 dead surveys (24,471.84 km) were used to calculate variation from mean and standard deviation for the 594 Beach/Surveys over all years. Trends were calculated for species for which no more than three years occurred in which encounter rate was 0. Temporal trends were determined for three categories of vertebrates: birds, pinnipeds (seals, sea lions, and fur seals) and cetaceans (dolphins, porpoises, and whales) (Figures 2-7). Encounter rates for each vertebrate category were summed by familial taxon. 5,300,756 live animals were included in this analysis (5,086,048 birds of 249 species or species groups, 212,692 pinnipeds of 9 species or species groups, and 2,016 cetaceans of 8 species or species groups). 34,747 dead animal were also included here (31,468 birds of 152 species or species groups, 3150 pinnipeds of 9 species or species groups, and 129 cetaceans of 16 species or species groups). Linear Regression was used to determine the significance of the trend. P-value is displayed to express strength of the trend; here we consider a p-value of <0.05 to be significant. Encounter rate and linear regression were also performed for the species of specific interest by the NCCMP (Figures 16-48). We calculated cumulative encounter rates for each of the four categories of vertebrates and present the data for each beach. The spatial distribution of each category of vertebrates is depicted cartographically, with the addition of otters, in Figures 8-15. Similar analyses were performed for marine mammals of specified interest by the NCCMP (Appendix G1-G10), and human use activities (Figure 49 and Appendix H1-H25).

2.0 Results and Discussion

2.1 Regional Temporal Trends and Spatial Patterns of Birds and Marine Mammals

Regional Temporal Trends of Live Animals by Vertebrate Category, 1995-2012
Here we look at annual trends of live birds, pinnipeds, and cetacean mean encounter rates using data from 33 beaches over 18 years. There is non-significant decline for live birds (Figure 3). The decline in bird encounter from 2008 through 2012 is driven by a decline in gull species (Figure 27) along Half Moon Bay beaches (Appendix F1, BW unpublished data). This may be due to implementation of best management practices (BMP) for landfill maintenance at nearby Ox Mountain Landfill during the same time period. Live pinnipeds showed a non-significant increase (Figure 4). This is supported by non-significant increases observed in California Sea Lion and Harbor Seal (Figures 32 and 33). Encounter rates of live cetaceans showed a significant increase over the survey period (Figure 4). This trend is driven by increasing encounter rates of near-shore species such as Harbor Porpoise (Figure 30), Bottlenose Dolphin, and Gray Whale (Appendix F3). Note that y axis scales are not consistent between species due to large variation in rates between species.
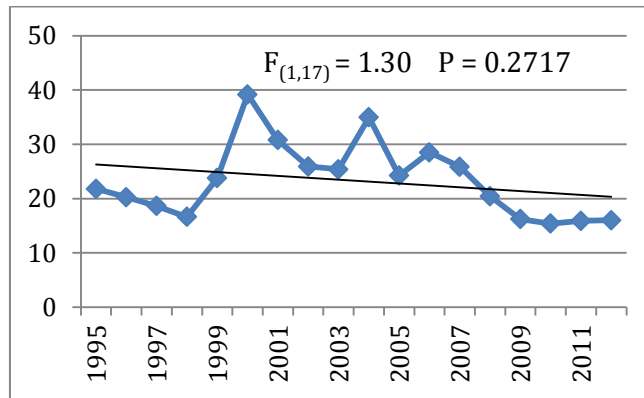
Figure 2. Live bird mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a non-significant decrease.
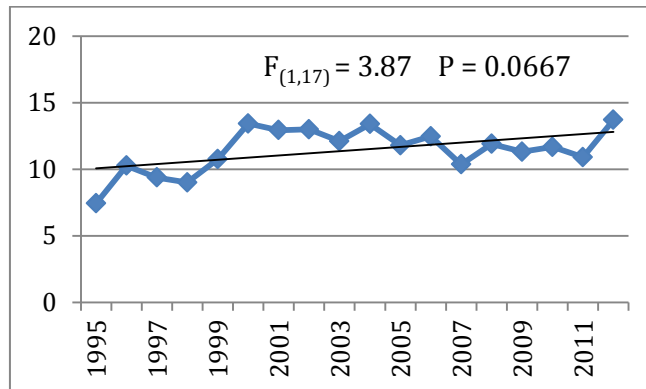
Figure 3. Live pinniped mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, P-value indicating a near-significant increase.
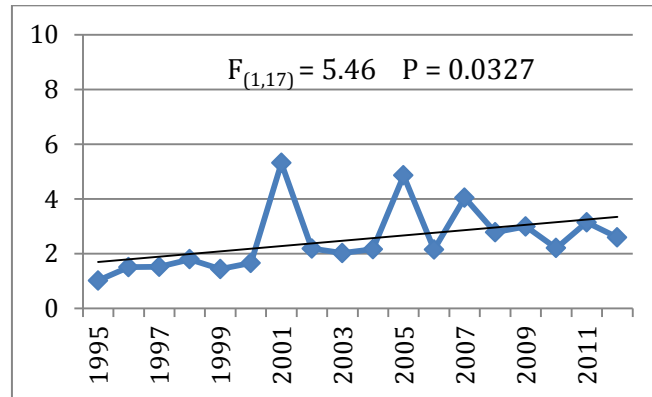
Figure 4. Live Cetacean mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a significant linear increase.

Regional Temporal Trends of Dead Animals by Vertebrate Category, 1995-2012

Here we look at mean annual trends of all dead birds, pinnipeds and cetacean encounter rates of 33 beaches over 18 years. Encounter rates of dead birds showed a significant linear increase over the survey period (Figure 5). This trend may be due to increasingly high annual variability of unusual mortality event (UME) in seabirds throughout the region. In some years wrecks of Northern Fulmar, Brown Pelican, Brandt's Cormorant, and California sea lion greatly increase the rates for dead birds and also pinnipeds (Nevins 2011, and BW unpublished data). Single oceanographic or climactic events can cause UME in both birds and mammals resulting in increased encounter. Sample size is low for dead marine mammals, especially cetaceans, making interannual trends difficult to identify. There is no apparent trend for dead pinnipeds and a non-significant slight decline in cetaceans (Figure 6 and 7). The Marine Mammal Center and the Marine Mammal Stranding Network remove both live and dead marine mammals from the beach. Small beached cetaceans are reported and removed from beaches quickly, resulting in lower encounter on Beach Watch surveys (Flannery pers com). Note that y axis scales are not consistent between species due to large variation in rates between species.
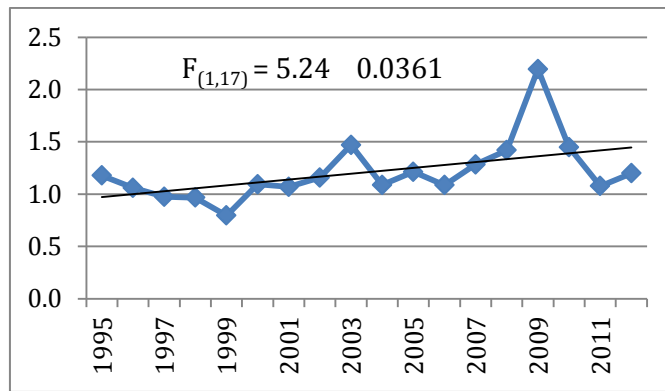
Figure 5. Dead bird mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a significant linear increase.
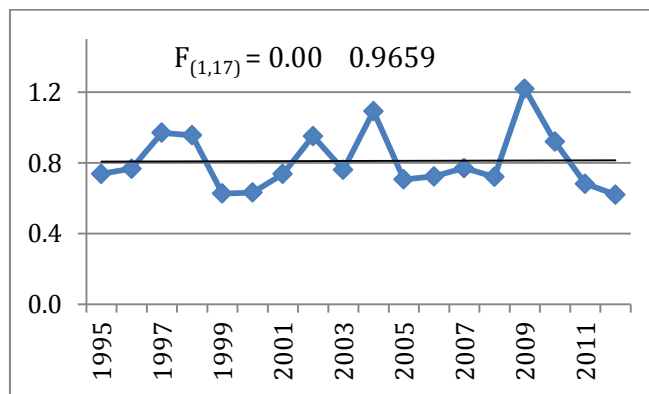
Figure 6. Dead pinniped mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing no significant change.
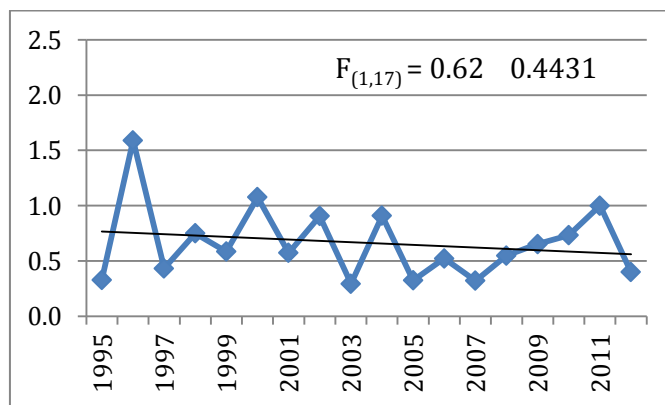
Figure 7. Dead cetacean mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a non-significant decrease.

Regional Spatial Distribution of Live Animals by Vertebrate Category, 1994-2012

Here we highlight regional patterns of occurrence with maps by vertebrate category (birds, pinnipeds, cetaceans with the addition of Sea Otters). Abundance bubbles of high, medium, low and none represent cumulative mean encounter from 1994 through 2012 for all beaches. Note that scale for rate bubbles is different for each map as rates of encounter vary greatly for vertebrate groups.

Live bird encounters highlight extremely high gull species use of San Francisco and San Mateo beaches drives this map reaching up to over 1200 birds per km. Notably Montara SMR, and Año Nuevo SMCA (which hosts a large breeding population) see some of the highest encounter rates in the region. Waste management in San Francisco and San Mateo are known to attract large numbers of gulls. See Appendix F1 for by species spatial occurrence.

Figure 8. Live bird encounter rate map, cumulative by beach, from 1994-2013. Ranges are considered low, medium or high, relative to cumulative rates (#/km) for other beaches. All beaches had at least a low number of birds present.

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Live pinniped encounters highlight beaches proximal to near-shore rookeries and haul outs, see Appendix G1-G10 for by species spatial occurrence. Harbor Seal and Northern Elephant Seal most abundant near their known rookeries (Appendix F2). Harbor Seal encountered most often near haul outs and rookeries in Tomales Bay, Point Reyes SMR, Duxbury Reef SMCA/Bolinas Lagoon, and Montara SMR (Appendix G1). Northern Elephant Seal encounter was high in Point Reyes SMR and Año Nuevo SMCA (Appendix F2). California Sea Lion encountered most often around the mouth to San Francisco Bay and Pillar Point/Half Moon bay, Año Nuevo SMCA (Appendix F2 and G4).
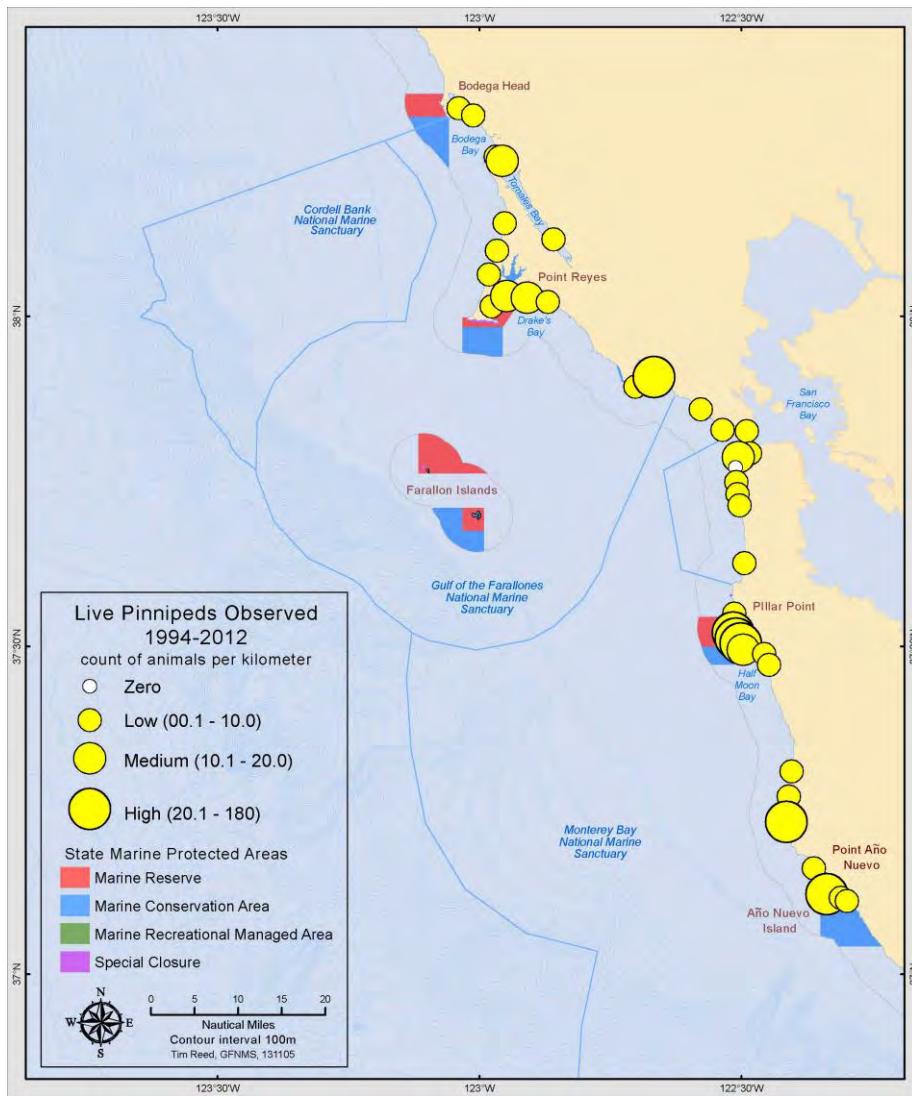
Figure 9. Live pinniped encounter rate map, cumulative by beach, from 1994-2013. Ranges are considered low, medium or high, relative to cumulative rates (#/km) for other beaches. No pinnipeds were observed at China Beach

The federally threatened species, Sea Otter, reaches the northern limit of its range within our survey area. Sea Otters were observed in small numbers in the Montara SMR/Half Moon Bay, and Año Nuevo SMCA (Figure 10). Sea Otters were rarely observed north of Montara SMR, and increase in numbers toward the south (Appendix G2).
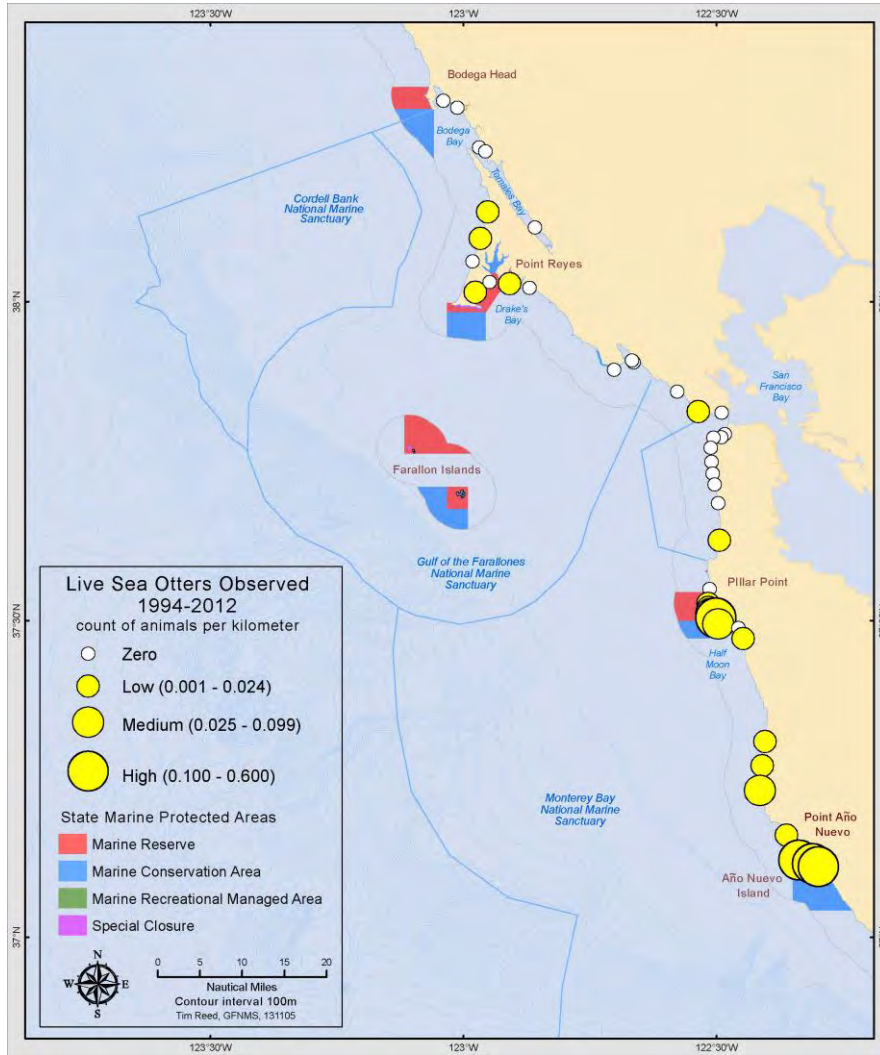
Figure 10. Live Sea Otter encounter rate map, cumulative by beach, from 1994-2013. Ranges are considered low, medium or high, relative to cumulative rates (#/km) for other beaches. No otters were observed at 28 beaches.

Live cetacean encounter rate map highlights bay beaches, which we know are driven by Harbor Porpoise and Bottlenose Dolphin sightings (Appendix F3). Beaches at the mouth of San Francisco Bay and Half Moon Bay having the highest incidents of live encounter (Figure 11). Live Harbor Porpoise were most often observed near larger bays: Point Reyes SMR/Drakes Bay, San Francisco, and Montara SMR/Half Moon Bay (Appendix G1).
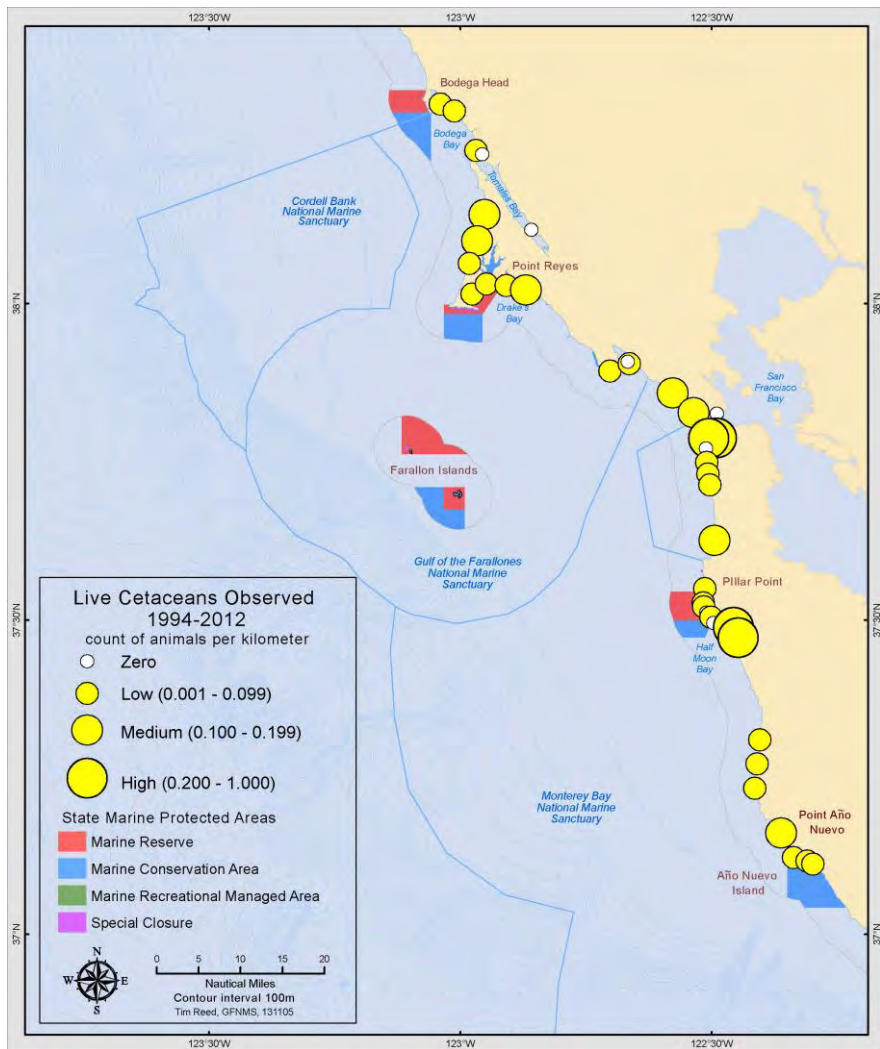
Figure 11. All live cetacean encounter rate map, cumulative by beach, from 1994-2013. Ranges are considered low, medium or high, relative to cumulative rates (#/km) for other beaches. No cetaceans were observed at 7 beaches, all highly protected beaches like those in Tomales Bay, and Bolinas Lagoon.

Regional Spatial Distribution of Dead Animals by Vertebrate Categories, 1994-2012

Dead bird encounter rate map highlights promontories such as Tomales Point, Point Reyes Peninsula, Bolinas, and Montara (Figure 12). Dead bird encounter was driven by four family groups: Alcids, Tubenoses, Cormorants and Gulls. Alcid deposition is some of the most consistent throughout the survey region (Appendix F1). Tubenose (Northern Fulmar and Sooty Shearwater being the most numerous) deposition is highest on Point Reyes beaches. Cormorants being most frequently observed on beaches surrounding the mouth of San Francisco Bay closer to some breeding colonies along the coast as well as in the bay at Alcatraz. Gull deposition is highest in Half Moon Bay (Appendix F1).
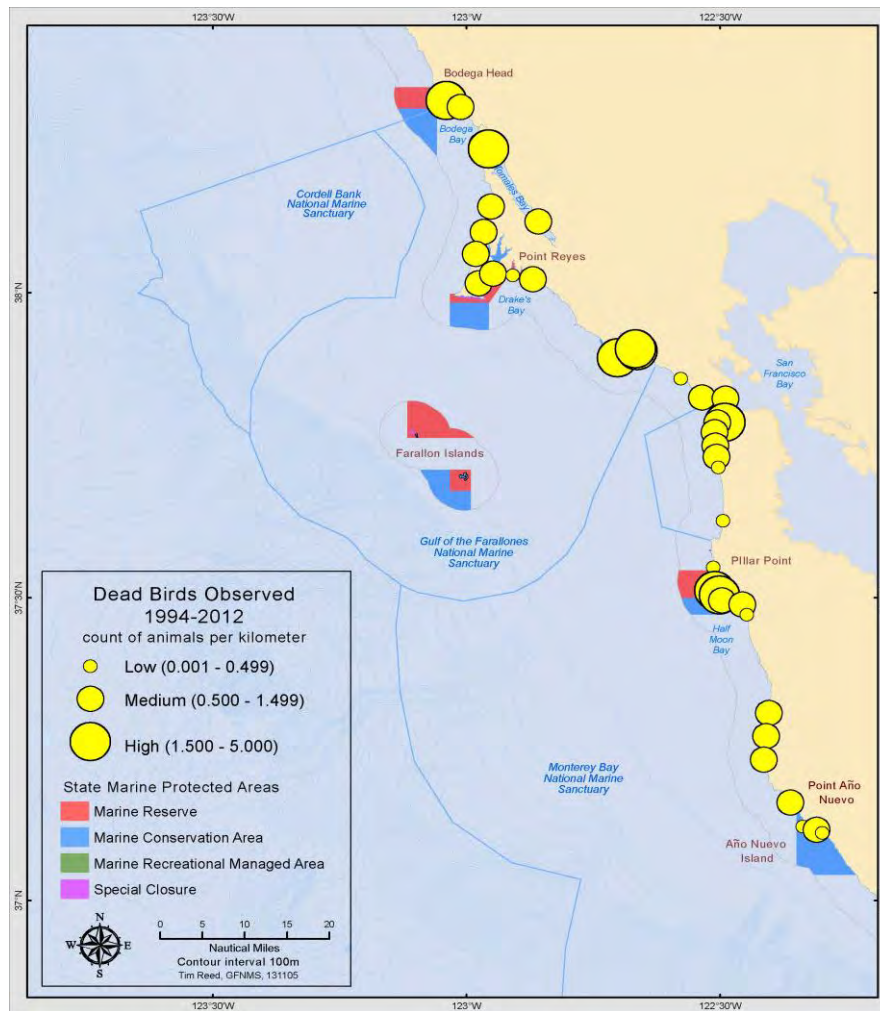
Figure 12. Dead bird encounter rate map, cumulative by beach, from 1994-2013. Ranges are considered low, medium or high, relative to cumulative rates (#/km) for other beaches. All beaches had at least a low number of dead birds present.

Dead Pinniped encounter peaks in encounter near rookeries and a fairly consistent low level of deposition throughout the survey region (Figure 13). Higher deposition of California Sea Lions and Harbor Seals, are seen in the Pillar Point and Half Moon Bay beaches, which are down wind and current from Montara SMR rookeries (Appendix F5). And Northern Elephant Seals, and California Sea Lions on the Año Nuevo SMCA. Steller Seal Lion were most often documented on beaches in the Bodega region, Point Reyes, near the mouth of San Francisco bay, Pillar Point, and Año Nuevo SMCA (Appendix G8). Notably, California Sea Lions increase toward the southern end of our survey region, and most often encountered around the mouth to San Francisco Bay and Pillar Point/Half Moon bay, Año Nuevo SMCA (Appendix G9). Harbor Seal were also encountered in low numbers on almost all beaches peaking near haul outs and rookeries in Tomales Bay, Point Reyes SMR, Duxbury Reef SMCA/Bolinas Lagoon, and Montara SMR (Appendix G10).
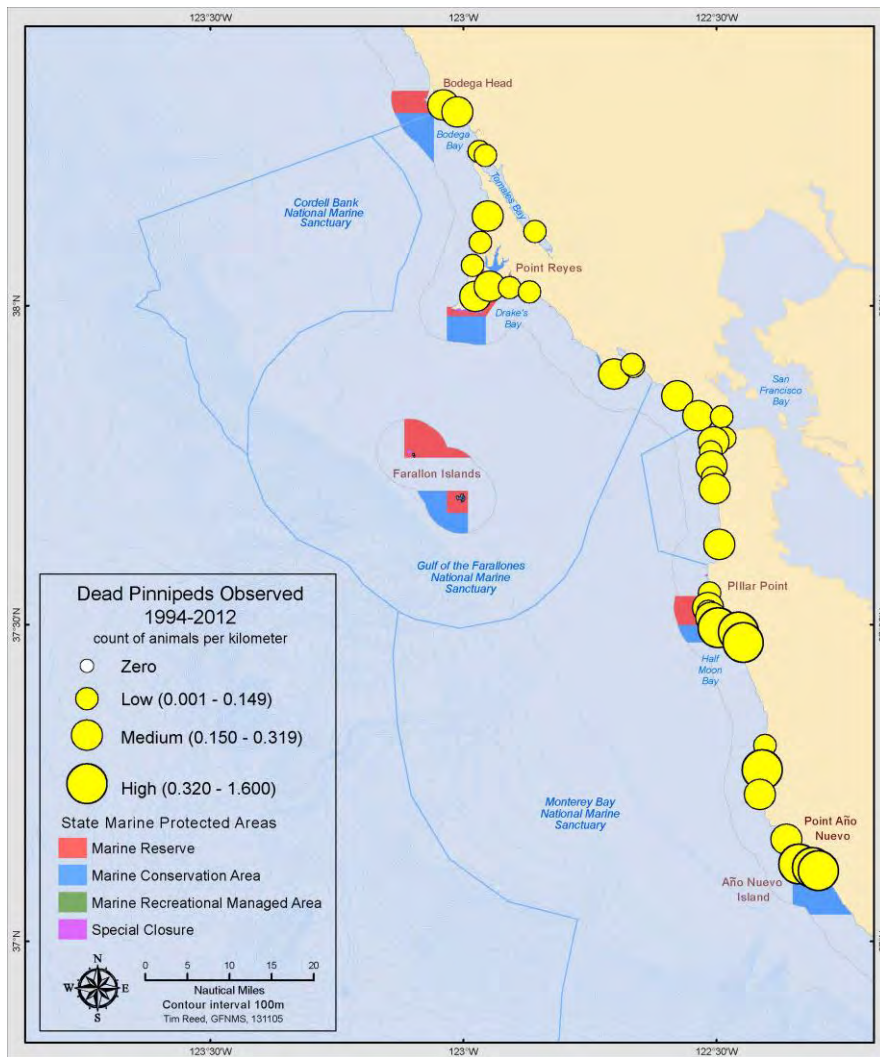
Figure13. All dead pinniped encounter rate map, cumulative by beach, 1994-2013. Ranges are considered low, medium or high, relative to cumulative rates (#/km) for other beaches. All beaches had at least a low number of pinnipeds birds present.

Dead Sea Otters were uncommon throughout the NCC MPAs and region (Figure 14). The dead encounter rates mirror those of live (Figure 10) were encounter is highest in the southern portion of our survey region, the northern extent of their range. Sea Otters were documented primarily from Montara SMR/Half Moon Bay beaches south, only a few individuals have been found North of Half Moon Bay (Appendix G7).
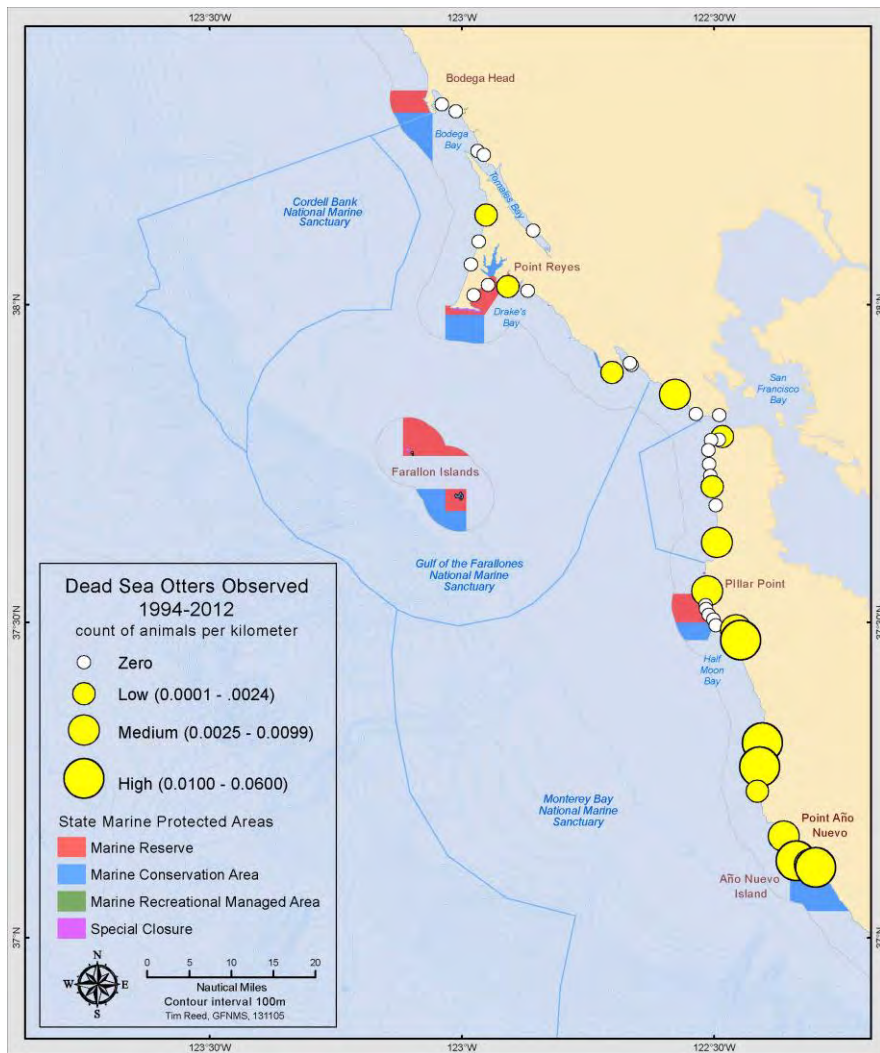
Figure 14. Dead Sea Otter encounter rate map, cumulative by beach, 1994-2013. Ranges are considered low, medium or high, relative to cumulative rates (#/km) for other beaches. No otters were observed at 26 beaches.

Dead cetacean encounter highlights probable human removal of cetaceans from beaches in densely populated areas. Notable lack of diversity and encounters within the highly populated centers where stranding's are quickly reported and TMMC and CAS respond most readily and remove the animals, farther from the population center diversity and numbers ramp up (Appendix F6). Notable exceptions are of large whales that cannot be removed from the beach such as Gray Whale encounters on Lands End and Muir Beach. Harbor Porpoise along ocean beach, near the mouth of San Francisco Bay, seem to be just numerous enough that are regularly observed on surveys despite carcass removal (Appendix G6). Dead encounters of marine mammals closely mirror live distribution (Figure 15). Dead Harbor Porpoise were most often observed near larger bays: Drakes, San Francisco, and Half Moon Bay (Appendix F6). They were also observed along the Ocean Beaches of San Francisco and Año Nuevo SMCA.

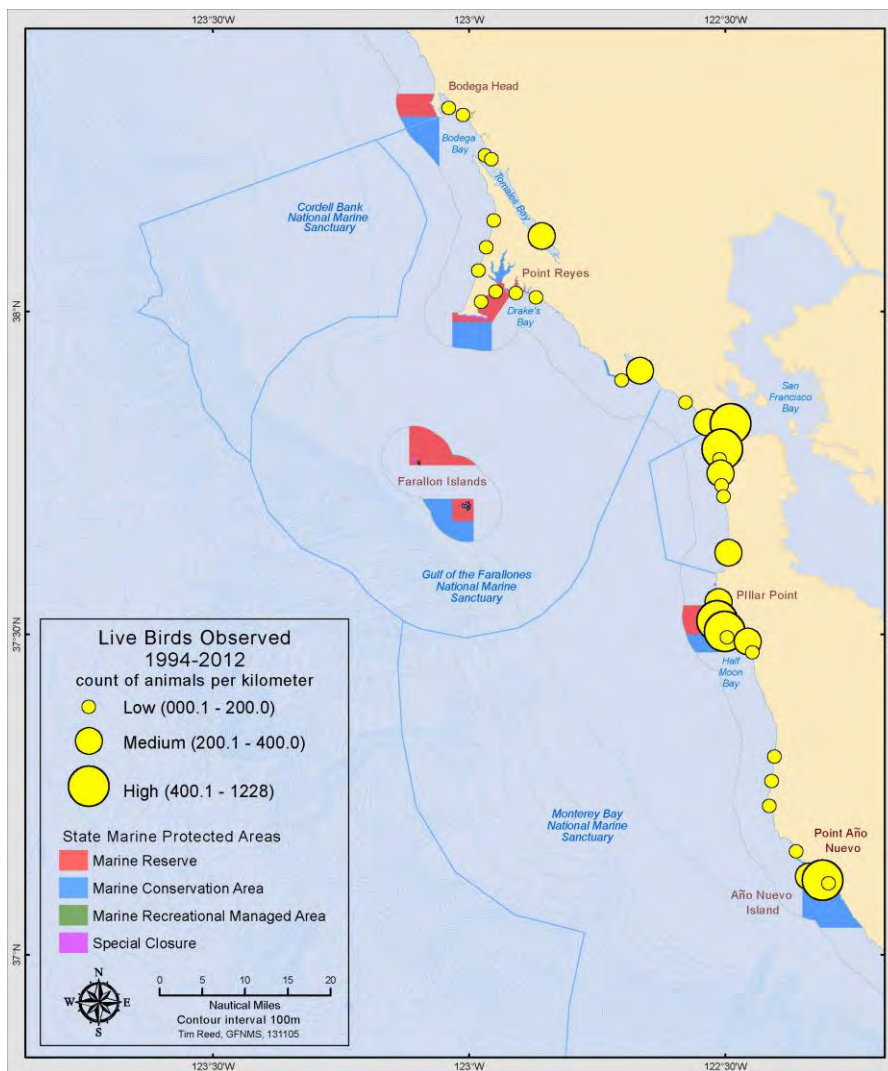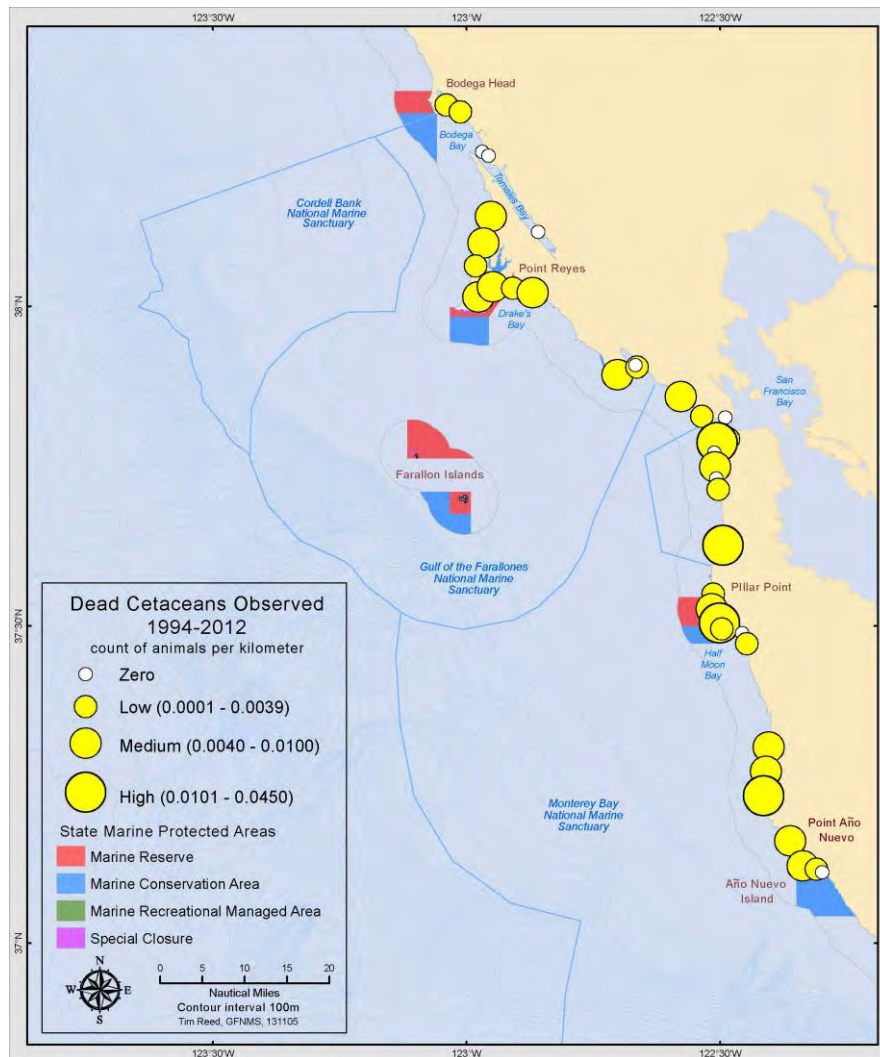**Figure 15.** All dead cetacean encounter rate map, cumulative by beach, 1994-2013. Ranges are considered low, medium or high, relative to cumulative rates (#/km) for other beaches. No cetaceans were observed at 12 beaches, primarily very sheltered beaches in lagoons, bays, and harbors.

2.2 Bird and Mammal Encounter by MPA and Reference

Table 2 summarizes the cumulative encounter rates for live species of specific interest, and the three vertebrate categories (bird, pinniped, and cetacean) within the NCC MPAs as well as a summary rate for reference beaches. Table 3 summarizes what species of specific interest are most abundant at each MPA and at all reference beaches summed.

Live Bird and Mammal Encounter by MPA and Reference 1994-2012

Live bird encounter rates were high higher within MPAs than reference sites (Table 2). Of the NCC MPAs, highest live bird encounter rates were at Montara SMR (1227/km, 455/km, 219/km and

212/km) and Año Nuevo SMCA (538 bird/km). Western Gull, Surf Scoter and Brandt's Cormorant were the most abundant species in the MPAs (Table 2 and Table 3).

Live pinniped encounter rates were highest within the NCC MPAs and beaches near rookeries at Point Reyes SMR, Duxbury Reef SMCA, Montara SMR, and Año Nuevo SMCA (Table 2). Harbor seals at Duxbury Reef SMCA, Montara SMR, and Point Reyes SMR. Harbor seals were the pinnipeds species of interest most likely to be observed and were found in each of the NCC MPAs except Año Nuevo SMCA (Table 2 and Table 3), and Cove Beach where elephant seals are the predominant pinniped (Appendix F2).

Live sea otters were low throughout the NCC MPAs, but were highest in the southern portion of our survey range at Montara SMR, Frenchman's Reef (0.2 otter/km) and Año Nuevo SMCA, 0.5 otter/km at North Point and Bradley beaches (Table 2, Table 3 and Figure 10).

Live cetacean encounter rates were very low throughout the NCC MPAs and reference sites (Table 2, Table 3 and Figure 11).

Table 2. Cumulative encounter rate (#/km) for live species of interest at each NCC MPA; 1994-2012. * Additional species included as potential indicators species within the same guild or foraging complex ecosystem are noted with asterisk.

	Point Reyes SMR	Point Reyes SMR	Point Reyes SMR	Duxbury Reef SMCA	Montara SMR	Montara SMR	Montara SMR	Montara SMR	Año Nuevo SMCA	Año Nuevo SMCA	Año Nuevo SMCA	
	Drakes Beach West	Drakes Beach East	Limantour Beach West	Bolinas Beach	Fitzgerald Marine Reserve, Weinke Way	Fitzgerald Marine Reserve, Entrance	Fitzgerald Marine Reserve, Distillery	Fitzgerald Marine Reserve, Frenchman's Reef	North Point	Cove Beach	Bradley	Reference Beaches
Western/Clark's Grebe	2.7	2.8	0.1	6.9	0.5	0.8	0.1	0.6	0.1	0.9	0.2	1.6
Brandt's Cormorant	0.9	1.2	3.3	7.4	14.4	4.9	2.5	3.1	2.6	3.1	4.5	3.5
Double-crested Cormorant	1.1	2.9	0.3	7.8	3.6	2.8	3.5	3.2	0.3	0.1	0.3	1.9
Pelagic Cormorant	0.4	0.1	0.1	0.6	7.4	3.4	1.7	0.9	0.9	2.1	0.8	0.4
Brant	0.8	4.8	3.6	10.8	0	0.3	0.7	0.1	2.9	0	0.3	2.2
Surf Scoter	22.0	11.5	8.2	1.1	0.7	0.3	0	0	1.9	6.7	8.9	6.8
Snowy Plover	0	0.7	4.5	0	0	0	0.3	0	0.2	0	0	2.0
Black Oystercatcher	0.1	0.1	0	0.3	0.9	1.4	1.7	1.4	0.8	0	2.1	0.2
Willet	2.1	3.0	2.8	1.7	0.5	1.5	4.6	1.7	0.5	1.0	0.3	5.4
Surfbird	0.1	0.2	0	0	0.2	0.2	0.8	0.2	0.1	0	0.5	0.1
Western Sandpiper	1.2	7.6	9.7	0.8	0	0.1	2.5	0.2	0.2	0.8	0	3.7
Western Gull*	13.3	21.2	6.3	13.3	29.9	32.8	38.3	26.5	7.4	42.3	23.2	18.8
Common Murre	0	0.2	0.1	0.8	0	0.7	0.7	0.1	0.1	0	0.2	0.4
Pigeon Guillemot	0	0.1	0	0	0	0	0	0	0	0.7	1.2	0.2
Marbled Murrelet	0	0	0	0	0	0	0	0	0	0	0	0
Harbor Porpoise	0.1	0	0	0	0	0	0	0	0	0	1.0	0
Southern Sea Otter	0	0	0	0	0	0	0.1	0.2	0.5	0.2	0.5	0
Steller Sea Lion	0	0	0	0	0	0	0	0	0	0	0	0
California Sea Lion*	0	0.1	0.1	0	0.1	0.1	0.1	0.1	0.5	0.1	0.2	0.1
Harbor Seal	1.2	15.0	15.1	3.1	4.6	50.7	32.2	32.2	2.5	0	0.1	2.5
All Birds	118.8	105.8	130.1	111.4	212.6	455.3	219.3	1227.5	208.2	538.0	114.4	184.8
All Pinnipeds	5.2	15.2	15.3	3.4	4.7	50.9	32.3	21.5	168.4	0.8	0.5	2.6
All Cetaceans	0.1	0	0.1	0	0	0	0	0	0	0.1	0	0.1

Table 3. Live species occurrence at MPA and reference beaches. High, moderate, low, and no occurrence based on cumulative encounter rates (#/km): 1994-2013.

	Point Reyes SMR Drakes Beach West	Point Reyes SMR Drakes Beach East	Point Reyes SMR Limantour Beach West	Duxbury Reef SMCA Bolinas Beach	Montara SMR Fitzgerald Marine Reserve, Weinke Way	Montara SMR Fitzgerald Marine Reserve, Entrance
High (2 per km and higher)	Surf Scoter Western Gull*	Western Gull* Harbor Seal Surf Scoter Western Sandpiper Brant	Harbor Seal Western Sandpiper Surf Scoter Western Gull* Snowy Plover Brant Brandt's Cormorant	Western Gull* Brant Double-crested Corm. Brandt's Cormorant Western/Clark's Grebe Harbor Seal	Western Gull* Brandt's Cormorant Pelagic Cormorant Harbor Seal Double-crested Corm.	Harbor Seal Western Gull* Brandt's Cormorant Pelagic Cormorant
Moderate (0.5-3 per km)	Western/Clark's Grebe Willet Western Sandpiper Harbor Seal Double-crested Corm. Brandt's Cormorant Brant	Willet Double-crested Corm. Western/Clark's Grebe Brandt's Cormorant Snowy Plover	Willet	Willet Surf Scoter Common Murre Western Sandpiper Pelagic Cormorant	Black Oystercatcher Surf Scoter Western/Clark's Grebe Willet	Double-crested Corm. Willet Black Oystercatcher Western/Clark's Grebe Common Murre
Low (0.1-0.5 per km)	Pelagic Cormorant Surfbird Black Oystercatcher Harbor Porpoise	Common Murre Surfbird Black Oystercatcher Pelagic Cormorant Pigeon Guillemot California Sea Lion*	Double-crested Corm. Western/Clark's Grebe Pelagic Cormorant Common Murre California Sea Lion*	Black Oystercatcher	Surfbird California Sea Lion*	Brant Surf Scoter Surfbird Western Sandpiper California Sea Lion*
None present	Common Murre California Sea Lion* Snowy Plover Pigeon Guillemot Southern Sea Otter Marbled Murrelet Steller Sea Lion	Harbor Porpoise Marbled Murrelet Southern Sea Otter Steller Sea Lion	Harbor Porpoise Marbled Murrelet Pigeon Guillemot Southern Sea Otter Surfbird Black Oystercatcher Steller Sea Lion	California Sea Lion* Surfbird Harbor Porpoise Pigeon Guillemot Steller Sea Lion Snowy Plover Marbled Murrelet Southern Sea Otter	Common Murre Brant Pigeon Guillemot Snowy Plover Southern Sea Otter Western Sandpiper Marbled Murrelet Harbor Porpoise Steller Sea Lion	Snowy Plover Southern Sea Otter Pigeon Guillemot Marbled Murrelet Harbor Porpoise Steller Sea Lion

Table 3 (continued). Live species occurrence at MPA and reference beaches. High, moderate, low, and no occurrence based on cumulative encounter rates (#/km): 1994-2013.

Montara SMR Fitzgerald Marine Reserve, Distillery	Montara SMR Fitzgerald Marine Reserve, Frenchman's Reef	Año Nuevo SMCA North Point	Año Nuevo SMCA Cove Beach	Año Nuevo SMCA Bradley	Refernce Beaches
Western Gull* Harbor Seal Willet Double-crested Corm.	Harbor Seal Western Gull* Double-crested Corm. Brandt's Cormorant	Western Gull*	Western Gull* Surf Scoter Brandt's Cormorant	Western Gull* Surf Scoter Brandt's Cormorant	Western Gull* Surf Scoter Willet Western Sandpiper Brandt's Cormorant
Western Sandpiper Brandt's Cormorant Pelagic Cormorant Black Oystercatcher Surfbird Brant Common Murre	Willet Black Oystercatcher Pelagic Cormorant Western/Clark's Grebe	Brant Brandt's Cormorant Harbor Seal Surf Scoter Pelagic Cormorant Black Oystercatcher Southern Sea Otter California Sea Lion* Willet	Pelagic Cormorant Willet Western/Clark's Grebe Western Sandpiper Pigeon Guillemot	Black Oystercatcher Pigeon Guillemot Harbor Porpoise Pelagic Cormorant Surfbird Southern Sea Otter	Harbor Seal Brant Snowy Plover Double-crested Corm. Western/Clark's Grebe
Snowy Plover California Sea Lion* Western/Clark's Grebe Southern Sea Otter	Western Sandpiper Surfbird Southern Sea Otter Common Murre Brant California Sea Lion*	Double-crested Corm. Snowy Plover Western Sandpiper Surfbird Common Murre Western/Clark's Grebe	Southern Sea Otter Double-crested Corm. California Sea Lion*	Willet Double-crested Corm. Brant Western/Clark's Grebe Common Murre California Sea Lion* Harbor Seal	Common Murre Pelagic Cormorant Pigeon Guillemot Black Oystercatcher Surfbird California Sea Lion*
Surf Scoter Pigeon Guillemot Marbled Murrelet Harbor Porpoise Steller Sea Lion	Surf Scoter Snowy Plover Pigeon Guillemot Marbled Murrelet Harbor Porpoise Steller Sea Lion	Steller Sea Lion Pigeon Guillemot Marbled Murrelet Harbor Porpoise	Common Murre Harbor Seal Brant Black Oystercatcher Harbor Porpoise Snowy Plover Surfbird Marbled Murrelet Steller Sea Lion	Marbled Murrelet Steller Sea Lion Snowy Plover Western Sandpiper	Harbor Porpoise Southern Sea Otter Marbled Murrelet Steller Sea Lion

Dead Bird and Mammal Encounter by MPA and Reference 1994-2012

Table 4 summarizes the cumulative encounter rates for live species of specific interest, and the three vertebrate categories (bird, pinniped, and cetacean) within the NCC MPAs as well as a summary rate for reference beaches. Table 5 summarizes what species of specific interest are most abundant at each MPA and at all reference beaches summed.

Dead bird encounter rates were highest at three Montara SMA beaches (4.094 bird/km, 2.212/km, 1.316/km), and at Duxbury Reef SMCA (2.369/km). Common Murre, Western/Clark's Grebe and Western Gull were the dead bird species of interest most likely to be observed (Table 4 and Table 5).

Encounter rates for dead pinnipeds within MPAs were highest at beaches near elephant seal rookeries at Año Nuevo SMCA (1.412/km, 0.754/km and 0.78/km) and Point Reyes SMR (0.234/km) (Table 4 and Table 5 and Figure 13). Harbor seal was the dead pinniped species of interest most likely to be observed throughout the region (0.014/km), but most likely pinniped species to be observed was the California sea lion (0.060/km) (Table 4 and Table 5).

Most dead otters within the MPAs were observed in Año Nuevo SMCA (0.009/km and 0.034/km) (Table 4). Dead otters were also observed along sheltered beaches of Half Moon Bay (Figure 14).

Dead cetaceans were uncommon throughout region (0.003/km) (Table 4). Most dead cetaceans were observed at beaches along bays and promontories of Point Reyes SMR (0.009 cetacean/km), Duxbury Reef SMCA, Año Nuevo SMCA (0.009/km), Duxbury Reef SMCA (0.005/km), and Montara SMR (0.005/km). Harbor Porpoise was the species most likely to be observed (Table 4 and Table 5).

Table 4. Cumulative encounter rate (#/km) for dead species of interest at each NCC MPA, 1994-2012. * Additional species included as potential indicators species within the same guild or foraging complex ecosystem are noted with asterisk.

	Point Reyes SMR Drakes Beach West	Point Reyes SMR Drakes Beach East	Point Reyes SMR Limantour Beach West	Duxbury Reef SMCA Bolinas Beach	Montara SMR Fitzgerald Marine Reserve, Weinke Way	Montara SMR Fitzgerald Marine Reserve, Entrance	Montara SMR Fitzgerald Marine Reserve, Distillery	Montara SMR Fitzgerald Marine Reserve, Frenchman's Reef	Año Nuevo SMCA North Point	Año Nuevo SMCA Cove Beach	Año Nuevo SMCA Bradley Beach	Reference Beaches
Western/Clark's Grebe	0.059	0.076	0.071	0.068	0.011	0.037	0.018	0.040	0.085	0.092	0.135	0.120
Brandt's Cormorant	0.047	0.045	0.046	0.065	0	0.029	0.012	0.032	0.087	0.092	0.067	0.105
Double-crested Cormorant	0.003	0.001	0.002	0.013	0	0	0	0	0.002	0	0.002	0.005
Pelagic Cormorant	0.010	0.009	0.006	0.010	0	0.004	0	0.003	0.007	0.023	0.015	0.011
Brant	0.001	0.003	0.001	0	0	0	0	0	0	0	0.002	0.105
Surf Scoter	0.013	0.042	0.021	0.009	0	0	0	0	0	0.051	0.034	0.027
Snowy Plover	0	0	0	0	0	0	0	0	0	0	0	0
Black Oystercatcher	0	0	0	0	0	0	0	0	0	0	0	0
Willet	0	0.008	0.009	0.001	0	0	0	0	0	0	0	0.002
Surfbird	0	0	0	0.001	0	0	0	0	0	0	0	0
Western Sandpiper	0	0	0.001	0	0	0	0	0	0	0	0	0
Western Gull*	0.039	0.080	0.060	0.026	0	0.008	0.022	0.005	0.046	0.387	0.128	0.131
Common Murre	0.099	0.203	0.212	0.061	0.005	0.037	0.031	0.100	0.264	0.249	0.166	0.342
Pigeon Guillemot	0.020	0.024	0.015	0.001	0	0.004	0	0.005	0.007	0.009	0.015	0.015
Marbled Murrelet	0	0	0.001	0.001	0	0	0	0	0	0	0	0.001
Harbor Porpoise	0.002	0.005	0.002	0.002	0	0	0	0	0	0.009	0	0.002
Southern Sea Otter	0	0	0.001	0.001	0	0	0	0	0.034	0.009	0.027	0.002
Steller Sea Lion	0.001	0	0	0.002	0	0.004	0	0	0.005	0.005	0.004	0.002
California Sea Lion*	0.051	0.040	0.021	0.035	0.042	0.046	0.071	0.046	0.341	0.207	0.236	0.060
Harbor Seal	0.014	0.068	0.034	0.042	0.026	0.026	0.012	0.016	0.019	0.018	0.013	0.014
All Birds	0.813	1.257	0.401	2.369	0.261	1.316	2.212	4.904	0.300	0.610	0.265	1.050
All Pinnipeds	0.176	0.234	0.122	0.166	0.168	0.114	0.178	0.134	1.412	0.754	0.780	0.090
All Cetaceans	0.009	0.009	0.002	0.005	0.005	0	0	0.020	0.009	0.002	0	0.003

Table 5. Dead species occurrence at MPA and reference beaches. High, moderate, low, and no occurrence based on cumulative encounter rates (#/km): 1994-2013.

	Point Reyes SMR	Point Reyes SMR	Point Reyes SMR	Duxbury Reef SMCA	Montara SMR	Montara SMR
	Drakes Beach West	Drakes Beach East	Limantour Beach West	Bolinas Beach	Fitzgerald Marine Reserve, Weinke Way	Fitzgerald Marine Reserve, Entrance
High (0.05 and higher)	Common Murre Western/Clark's Grebe California Sea Lion* 	Common Murre Western Gull* Western/Clark's Grebe Harbor Seal	Common Murre Western/Clark's Grebe Western Gull*	Western/Clark's Grebe Brandt's Cormorant Common Murre		
Moderate (0.01-0.049)	Brandt's Cormorant Western Gull* Pigeon Guillemot Harbor Seal Surf Scoter Pelagic Cormorant	Brandt's Cormorant Surf Scoter California Sea Lion* Pigeon Guillemot	Brandt's Cormorant Harbor Seal California Sea Lion* Surf Scoter Pigeon Guillemot	Harbor Seal California Sea Lion* Western Gull*	California Sea Lion* Harbor Seal Western/Clark's Grebe	California Sea Lion* Western/Clark's Grebe Common Murre Brandt's Cormorant Harbor Seal
Low (0.0001-0.009)	Double-crested Corm. Harbor Porpoise Brant Steller Sea Lion	Pelagic Cormorant Willet Harbor Porpoise Brant Double-crested Corm.	Willet Pelagic Cormorant Double-crested Corm. Harbor Porpoise Brant Western Sandpiper Marbled Murrelet Southern Sea Otter	Double-crested Corm. Pelagic Cormorant Surf Scoter Harbor Porpoise Steller Sea Lion Willet Surfbird Pigeon Guillemot Marbled Murrelet Southern Sea Otter	Common Murre	Western Gull* Pelagic Cormorant Pigeon Guillemot Steller Sea Lion
None Present	Snowy Plover Black Oystercatcher Willet Surfbird Western Sandpiper Marbled Murrelet Southern Sea Otter	Snowy Plover Black Oystercatcher Surfbird Western Sandpiper Marbled Murrelet Southern Sea Otter Steller Sea Lion	Black Oystercatcher Steller Sea Lion Snowy Plover Surfbird	Brant Snowy Plover Black Oystercatcher Western Sandpiper	Brandt's Cormorant Double-crested Corm. Pelagic Cormorant Brant Surf Scoter Snowy Plover Black Oystercatcher Willet Surfbird Western Sandpiper Western Gull* Pigeon Guillemot Marbled Murrelet Harbor Porpoise Southern Sea Otter Steller Sea Lion	Double-crested Corm. Brant Surf Scoter Snowy Plover Black Oystercatcher Willet Surfbird Western Sandpiper Marbled Murrelet Harbor Porpoise Southern Sea Otter

Table 5 (continued). Dead species occurrence at MPA and reference beaches. High, moderate, low, and no occurrence based on cumulative encounter rates (#/km): 1994-2013.

Montara SMR	Montara SMR	Año Nuevo SMCA	Año Nuevo SMCA	Año Nuevo SMCA	
Fitzgerald Marine Reserve, Distillery	Fitzgerald Marine Reserve, Frenchman's Reef	North Point	Cove Beach	Bradley Beach	Reference Beaches
California Sea Lion*	Common Murre	California Sea Lion* Common Murre Brandt's Cormorant Western/Clark's Grebe	Western Gull* Common Murre California Sea Lion* Brandt's Cormorant Western/Clark's Grebe Surf Scoter	California Sea Lion* Common Murre Western/Clark's Grebe Western Gull*	Common Murre Western Gull* Western/Clark's Grebe Brandt's Cormorant Brant
Common Murre Western Gull* Western/Clark's Grebe Brandt's Cormorant Harbor Seal	California Sea Lion* Western/Clark's Grebe Brandt's Cormorant Harbor Seal	Western Gull* Southern Sea Otter Harbor Seal	Pelagic Cormorant Harbor Seal	Brandt's Cormorant Surf Scoter Southern Sea Otter Pelagic Cormorant Pigeon Guillemot Harbor Seal	California Sea Lion* Surf Scoter Pigeon Guillemot Harbor Seal Pelagic Cormorant
	Western Gull* Pigeon Guillemot Pelagic Cormorant	Pelagic Cormorant Pigeon Guillemot Steller Sea Lion Double-crested Corm.	Pigeon Guillemot Harbor Porpoise Southern Sea Otter Steller Sea Lion	Steller Sea Lion Double-crested Corm. Brant	Double-crested Corm. Southern Sea Otter Harbor Porpoise Willet Steller Sea Lion Marbled Murrelet
Double-crested Corm. Pelagic Cormorant Brant Surf Scoter Snowy Plover Black Oystercatcher Willet Surfbird Western Sandpiper Pigeon Guillemot Marbled Murrelet Harbor Porpoise Southern Sea Otter Steller Sea Lion	Double-crested Corm. Brant Surf Scoter Snowy Plover Black Oystercatcher Willet Surfbird Western Sandpiper Marbled Murrelet Harbor Porpoise Southern Sea Otter Steller Sea Lion	Brant Surf Scoter Snowy Plover Black Oystercatcher Willet Surfbird Western Sandpiper Marbled Murrelet Harbor Porpoise	Double-crested Corm. Brant Snowy Plover Black Oystercatcher Willet Surfbird Western Sandpiper Marbled Murrelet	Snowy Plover Black Oystercatcher Willet Surfbird Western Sandpiper Marbled Murrelet Harbor Porpoise	Black Oystercatcher Snowy Plover Surfbird Western Sandpiper

2.3 Trends of Live and Dead Animals, by Specific Species of Interest, 1995-2012

We analyzed all 20 specific species of interest for linear trends in both live and dead encounter rates. Two live species (Marbled Murrelet n=24 and Steller Sea Lion n=11) due to extremely low sample size. These data are not shown here. Of the remaining 18 live, five species had significant trends (Table 6). Five dead species (Snowy Plover n=1, Black Oystercatcher n=4, Surfbird n=2, Western Sandpiper n=3 Marbled Murrelet n=14) also due to extremely low sample size. These data are not shown here. Note that all of these species are small and may be consumed whole by predators and or are a rare or uncommon species. Of the remaining 15 dead, two had significant trends (Table 6).

Table 6. Specific Species of Interest with Significant (< 0.05 P value) Linear Trends

Live	Black Oystercatcher	P = 0.0002	
Live	Brant	P = 0.0027	
Dead	Brant	P = 0.0387	Increasing
Live	Double-crested Cormorant	P = 0.0018	
Live	Harbor Porpoise	P = 0.0014	
Live	Willet	P = <.0001	Declining
Dead	Surf Scoter	P = 0.005	

Trends of Annual Encounter Rates of Live Bird Species of Interest, 1995-2012

Of our 14 target species of birds, 9 showed increasing trends (3 had significant linear trends) and 5 showed decreasing trends (1 significant). We observe high annual variability in most species, likely due to prey availability locally and in previous wintering or breeding location and annual breeding productivity of the species. Note that y axis scales are not consistent between species.

$F_{(1,17)} = 0.00$ $P = 0.9488$

Figure 16. Live Western/Clarks Grebe mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing no significant change. The baitfish stock crash in 2009 is known to have affected this species along with Brandt's Cormorants and California Sea Lions (Figures 17 and 32) (USGS).

Figure 17. Live Brandt's Cormorant mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a non-significant decline. The baitfish stock crash in 2009 is known to have affected this species along with Western/Clark's Grebes and California Sea Lions (Figures 16 and 32) (USGS).

Figure 18. Live Double-crested Cormorant mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a significant linear increase.
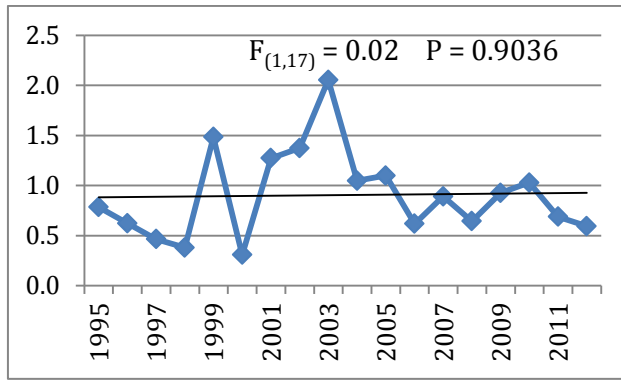
Figure 19. Live Pelagic Cormorant mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing no significant change.
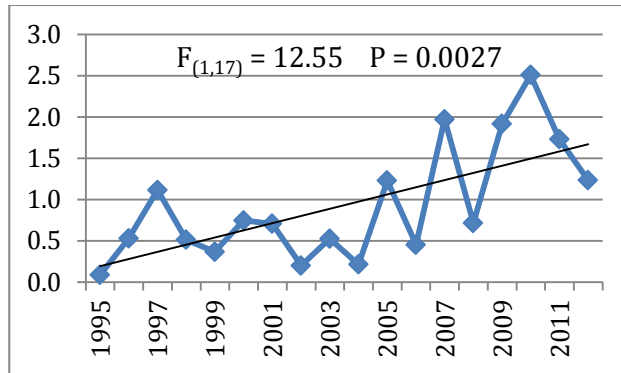
Figure 20. Live Brant mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a significant linear increase. These trends are consistent with recovery seen in the local region since the 1990s (Shuford 2008).

Figure 21. Live Surf Scoter mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing no significant change.

Figure 22. Live Snowy Plover mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing non-significant increase. This apparent increase could be due to a combination of management actions including habitat restoration, predator abatement, and restriction of human uses in breeding habitat (USFWS).
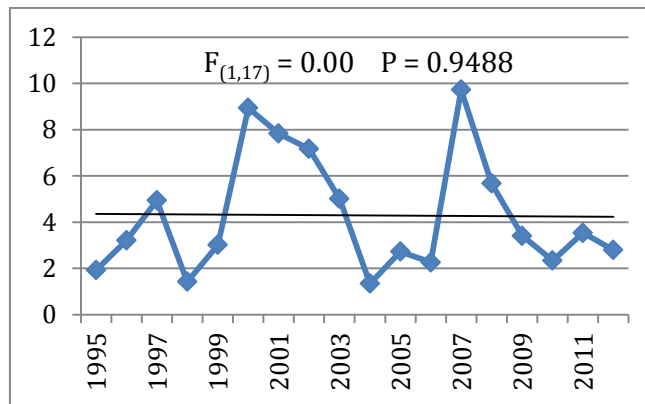

Figure 23. Live Black Oystercatcher mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a significant linear increase. Limited regional information shows this increase is consistent with other local findings. Limiting factors for Oystercatchers are nesting sites and forage (Tessler 2007).

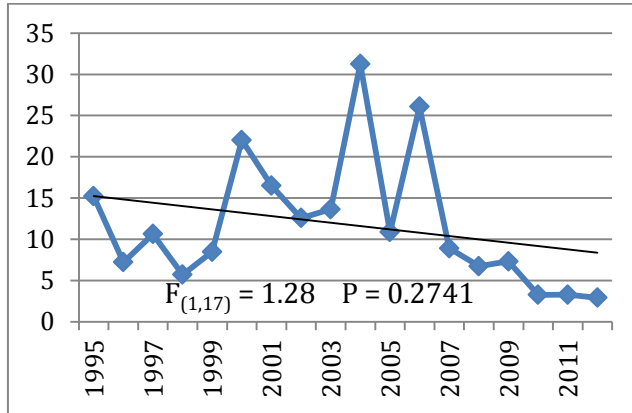**Figure 24.** Live Willet mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a highly significant linear decrease. Further inquiry is warranted to determine the cause of this decline.

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Figure 25. Live Surfbird mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing no significant change.

Figure 26. Live Western Sandpiper mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a non-significant decline.

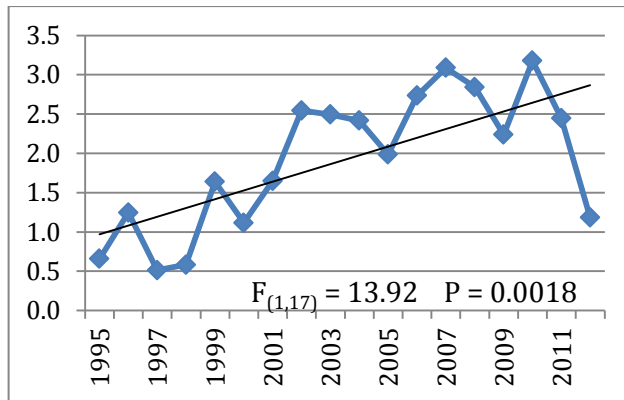**Figure 27.** Live Western Gull mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a non-significant increase. The decline in encounter observed in 2007 may be due to implementation of waste management controls in San Francisco and along the San Mateo coast.

Figure 28. Live Common Murre mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a non-significant decrease.

Figure 29. Live Pigeon Guillemot mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a significant linear increase.

Trends of Annual Encounter Rates of Live Mammal Species of Interest, 1995-2012

Figure 30. Live Harbor Porpoise mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a significant linear increase.
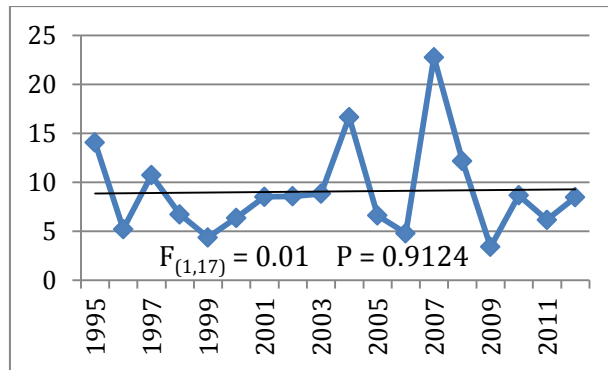
31

$F_{(1,17)} = 1.75$ $P = 0.2044$

Figure 31. Live Sea Otter mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a non-significant decline.

$F_{(1,17)} = 0.21$ $P = 0.6516$
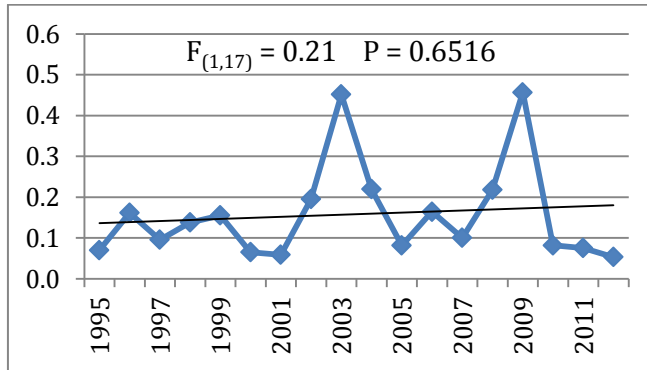
Figure 32. Live California Sea Lion mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, sh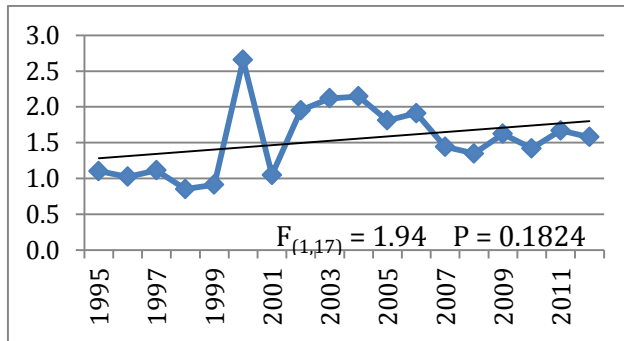owing a non-significant increase. The 2008 spike in encounters for this species occurred during a UME for this species related to prey decline that similarly affected Brandt's Cormorant and Western/Clark's Grebe (USGS). Beached dying animals drive the increase in this species.
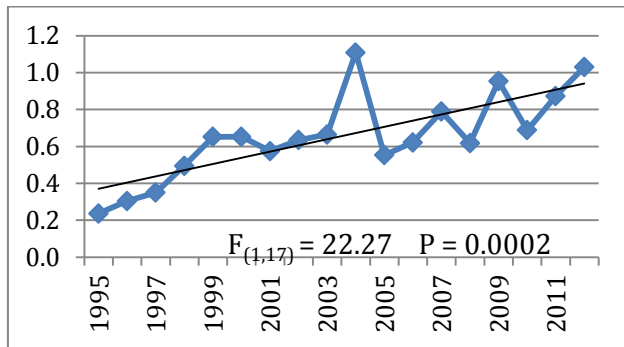

$F_{(1,17)} = 3.44$ $P = 0.0823$

Figure 33. Live Harbor Seal mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a non-significant increase. The slight increase observed here is mirrored in other local data sets (PRNS unpublished data).

Trends of Annual Encounter Rates of Dead Bird Species of Interest, 1995-2012

Dead bird annual encounter trends of 15 species show 7 species with varying strength trends (1 significant), and 6 decreasing trends (1 significant). We see mirroring patterns in live and dead encounter in Willet (Figure 24 and 40) and Brant (Figure 20 and 38), as live encounter decreases so does live encounter. We also observe strong increases in dead encounter related to the 2007-2008 baitfish stock declines in Brandt's dead (Table 35) and California Sea Lion (Figure 47). The Cosco Busan Oil spill of 2007 may be related to declines in Common Murre (Figure 42), and Western/Clark's Grebes (Table 34). Note that y axis scales are not consistent between species.
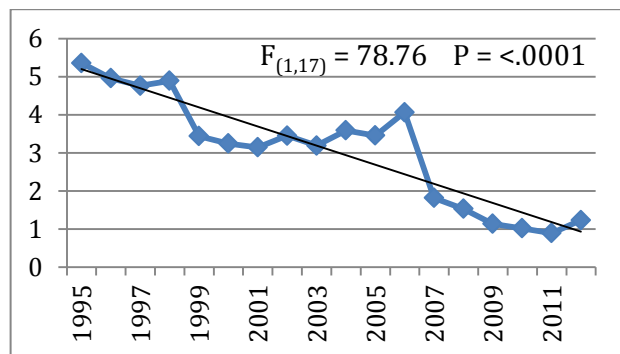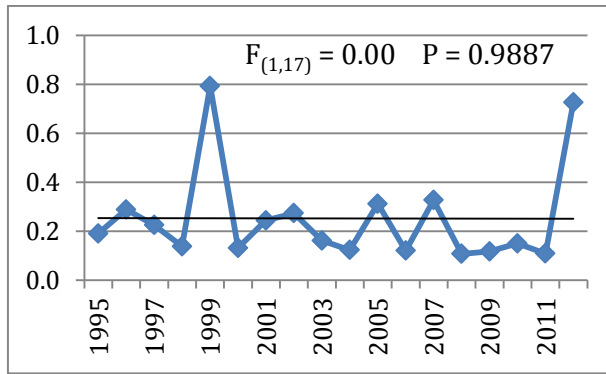

Figure 34. Dead Western/Clark's Grebe mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a non-significant increase. The notable high encounter in 2008 was caused by the baitfish decline of the same year which also affected Brandt's Cormorants and California Sea Lions (USGS).

Figure 35. Dead Brandt's Cormorant mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys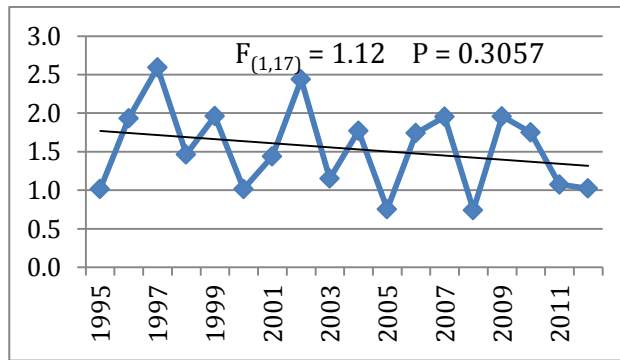 from 33 beaches over 18 years, showing a non-significant increase. The notable high encounter in 2008 is related to lack of prey base during the baitfish decline of the same year which also greatly affected California Sea Lions (Figure 47) (USGS).

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Figure 36. Dead Double-crested Cormorant mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a non-significant increase.
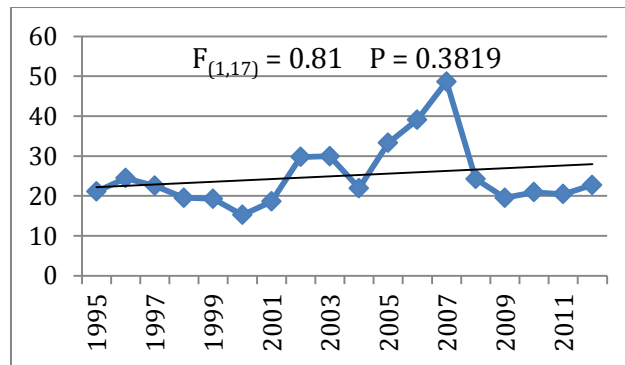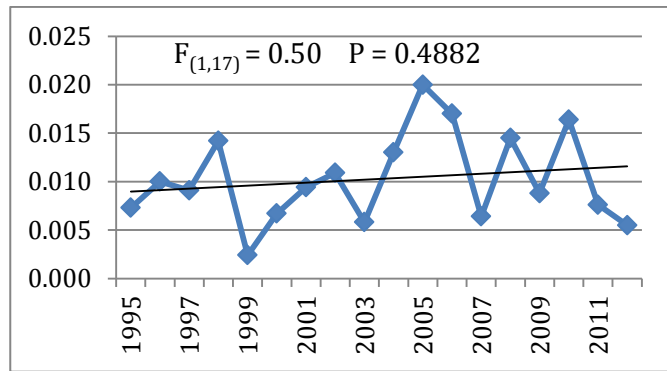

Figure 37. Dead Pelagic Cormorant mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a non-significant increase.
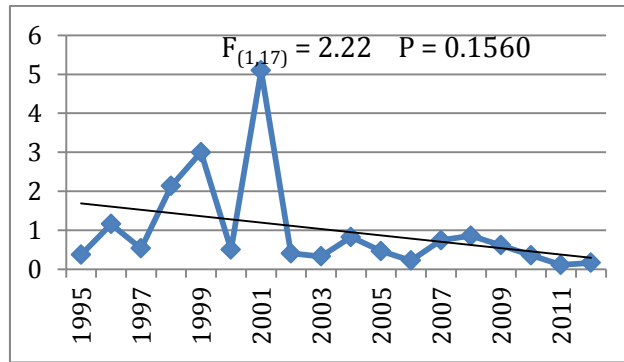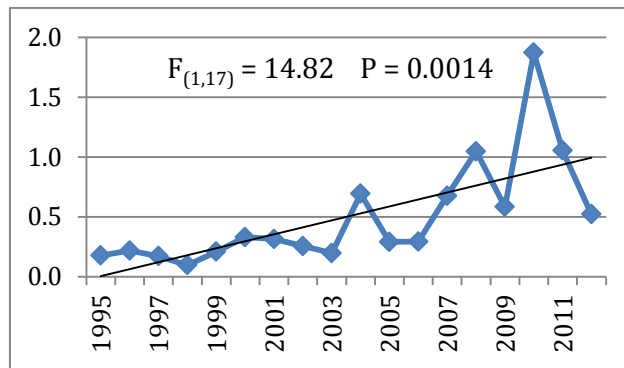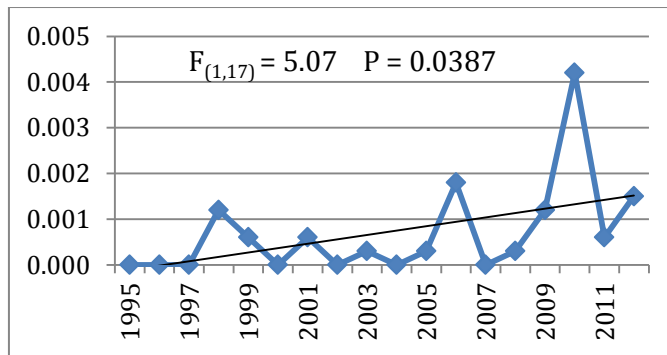

Figure 38. Dead Brant mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a significant linear increase. This may be due to declining local habitat for this species, or simply due to a significant increase in live numbers in the region (Figure 20).
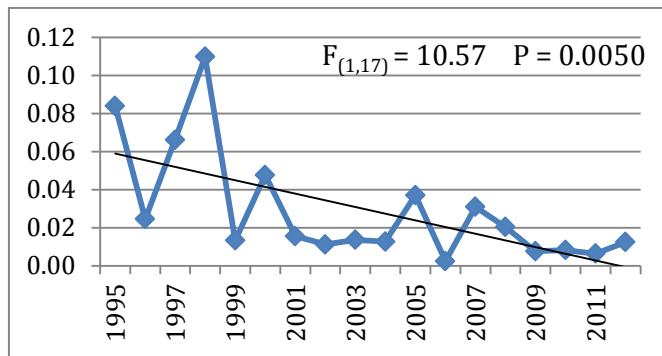
Figure 39. Dead Surf Scoter mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a significant linear decline. In 1995 this Species suffered a die off due to infestation of Acanthocephala sp., or spiny headed worms found in mole crabs (FMSA fact sheet).
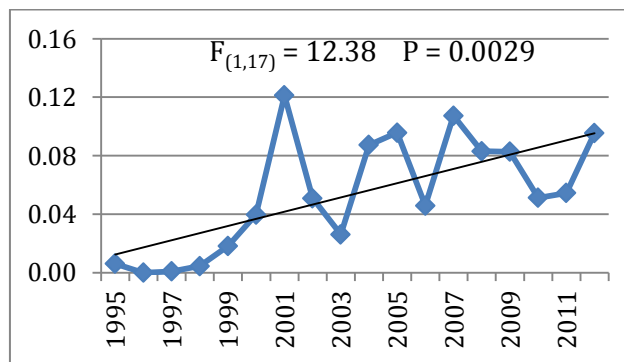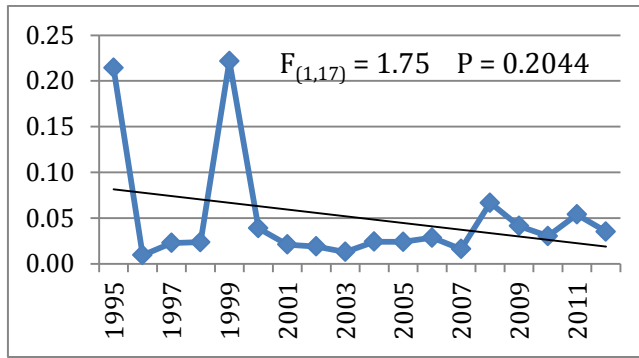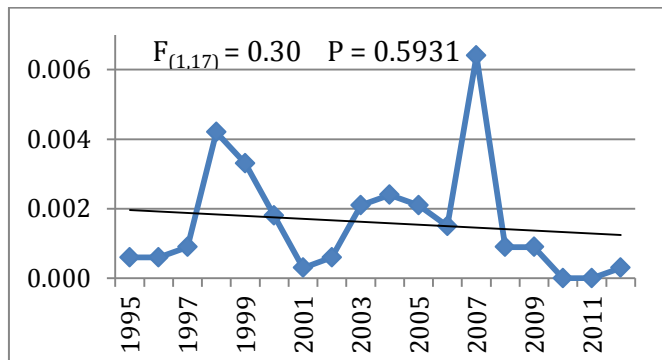

Figure 40. Dead Willet mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a non-significant decline. Possible slight overall decline in dead deposition may reflect highly significant declining live encounter rates (Figure 24).
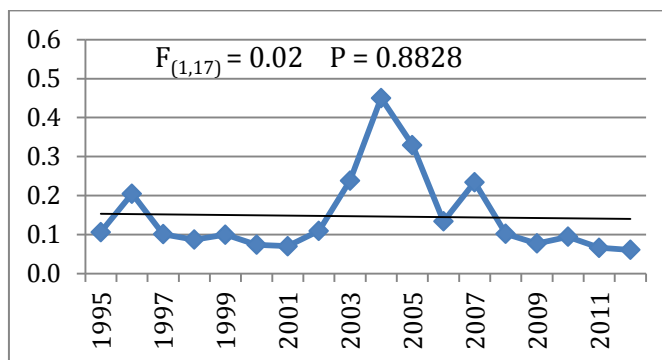
Figure 41. Dead Western Gull mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a non-significant decline. Dead encounter pattern may reflect non-significant live encounter, declines in dead when overall live encounters are also declining.
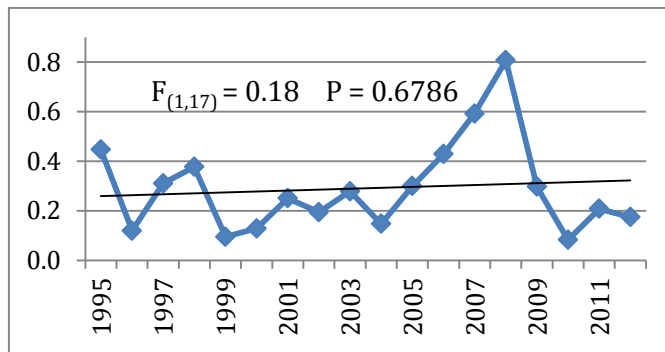
Figure 42. Dead Common Murre mean annual encounter rates (#/km) and linear trend using data from11,058 surveys from 33 beaches over 18 years, showing a non-significant increase. The high encounter in 2008 with subsequent drop may be related to 2007 Cosco Busan oil spill (Hampton 2008 and BW unpublished data).
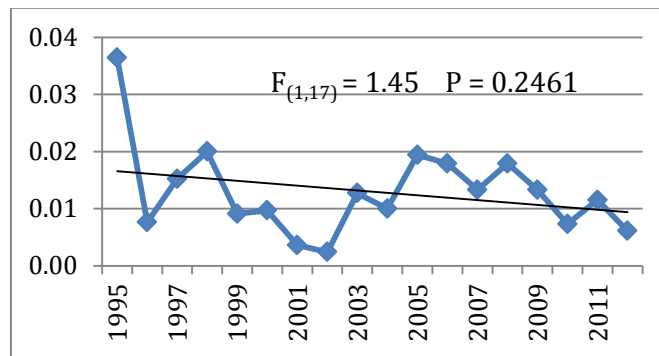
Figure 43. Dead Pigeon Guillemot mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a non-significant decline.

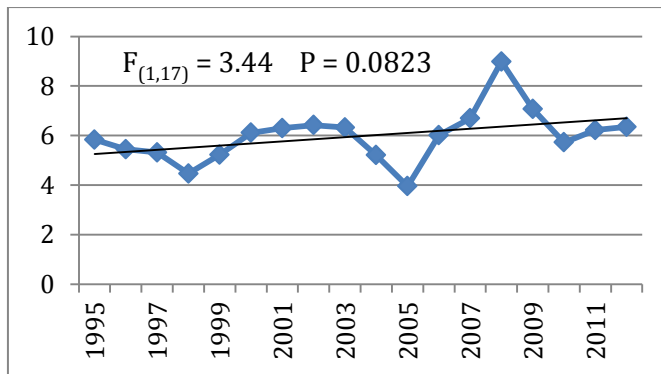Trends of Annual Encounter Rates of Dead Marine Mammal Species of Interest, 1995-2012
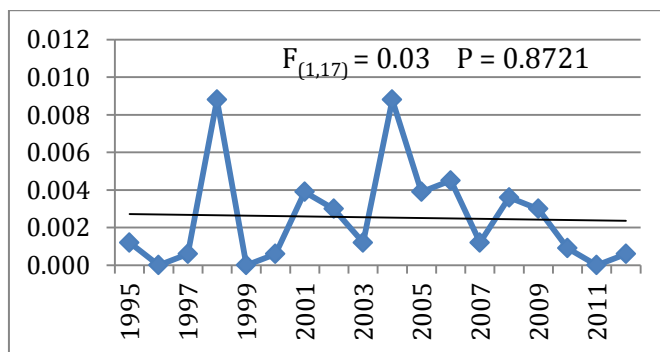
Figure 44. Dead Harbor Porpoise mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a non-significant decline. Note that incidence of porpicide between Bottle-nose Dolphin and Harbor Porpoise has increased since 2011. Carcass recovery has increased since that time (Flannery pers com).
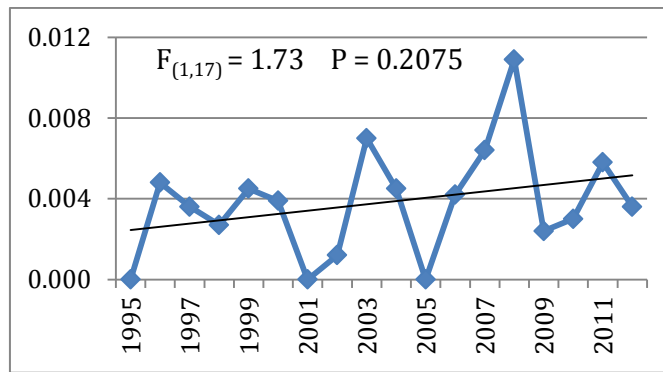
Figure 45. Dead Sea Otter mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a non-significant increase.
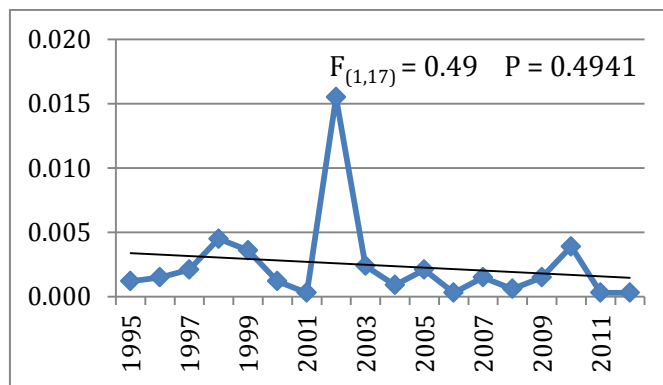
Figure 46. Dead Steller Sea Lion mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a non-significant decline.
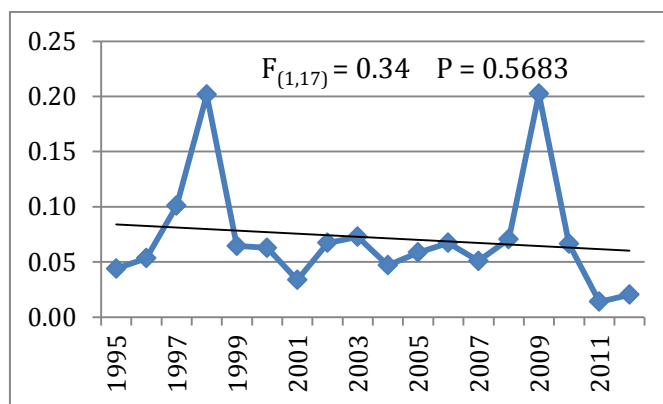
Figure 47. Dead California Sea Lion mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a non-significant decline. Note 1998 increase in encounter was caused by the 1997-1998 El Nino Southern Oscillation (ENSO) perturbation in baitfish (Gulland 2000). 2009 high encounter values reflecting baitfish crash and high mortality (USGS).
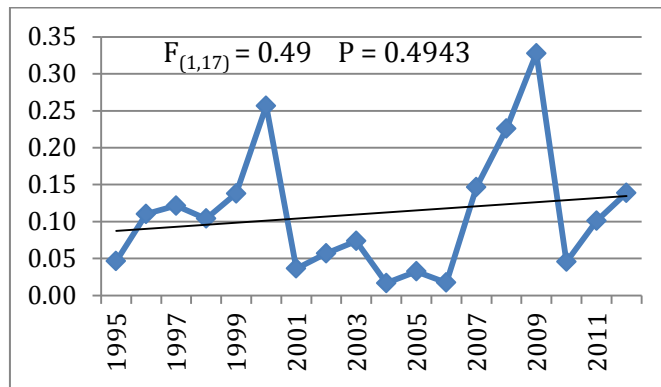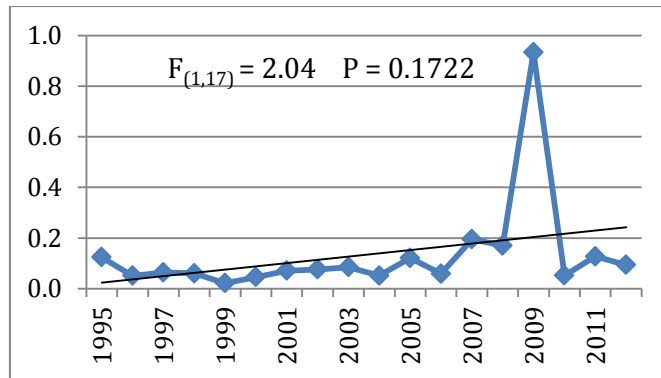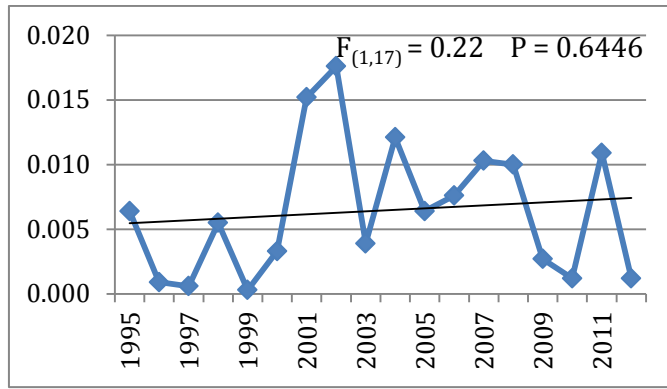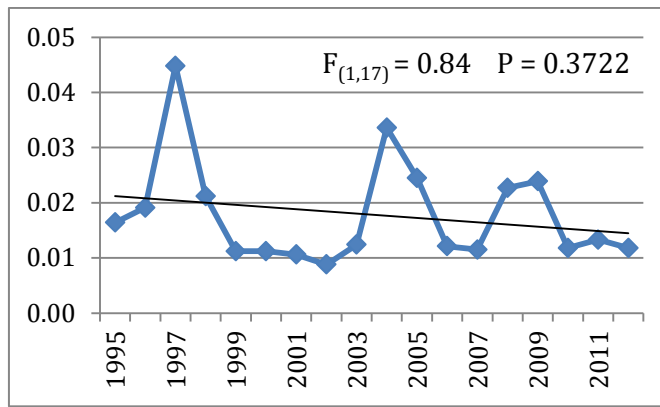
Figure 48. Dead Harbor Seal mean annual encounter rates (#/km) and linear trend using data from 11,058 surveys from 33 beaches over 18 years, showing a non-significant decline.

2.4 Spatial Variation in Human Use Observations

Human use encounter rates presented here are indicative for human uses on sandy beaches and not for near shore or coastal activities such as any boating activities, because human use activities are documented on the beach and 30 m from the shoreline. Human Uses were observed at higher rates closer to urban centers (Figure 49 and Appendix H1-H25). The most common human uses were Person on Beach, Dog not on Leash, Surfer, and Dog on Leash (Table 7 and Appendix H). Highest encounter rates were at beaches closest to densely populated areas of San Francisco metropolitan area and not within most NCC MPAs. However, high rates on People on Beach (60.24/km) were observed Montara SMRA, at the entrance to the Fitzgerald Marine Reserve.
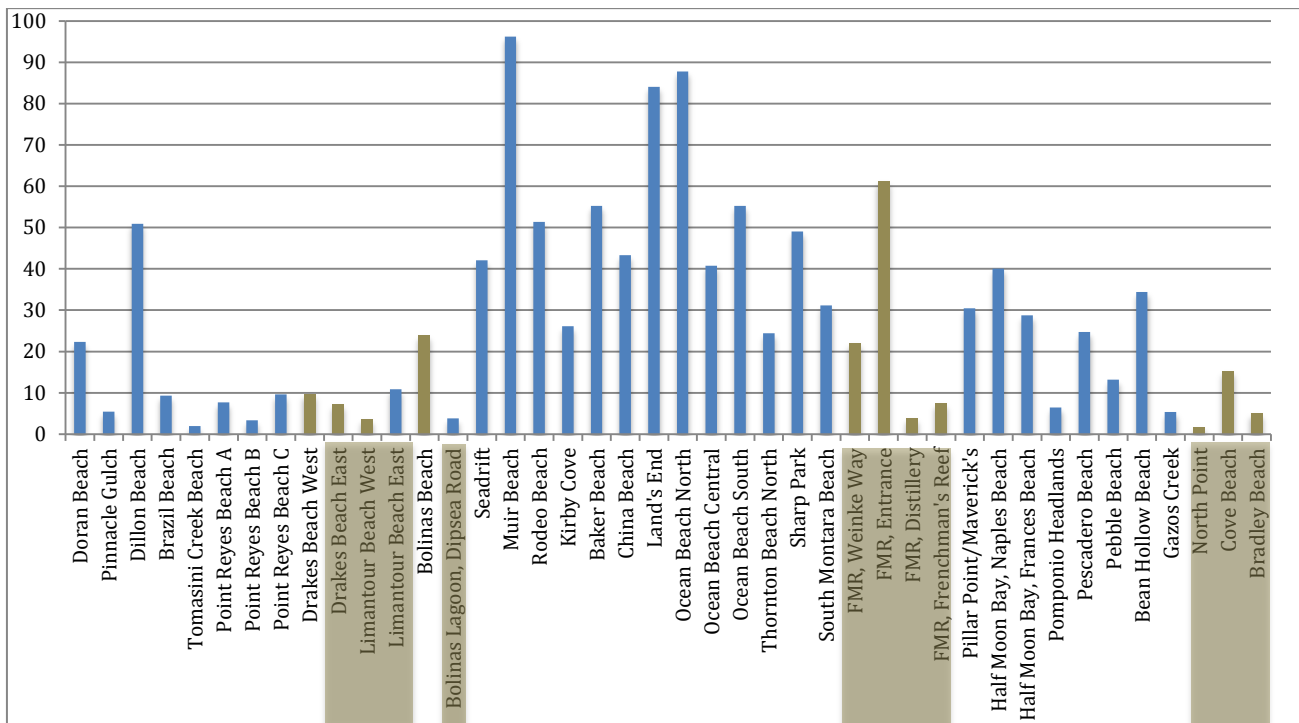
Figure 49. Human use cumulative encounter rate (#/km) by beach, 1994-2012. All activities combined. Brown indicates beaches within MPAs.

Table 7. Human use occurrence by MPA. High, moderate, low, and no occurrence based on cumulative encounter rates (#/km): 1994-2013. Zero encounters are not presented here.

	Point Reyes SMR Drakes Beach West	Point Reyes SMR Drakes Beach East	Point Reyes SMR Limantour Beach West	Duxbury Reef SMCA Bolinas Beach	Montara SMR Fitzgerald Marine Reserve, Weinke Way
High (1 per km and above)	Person on Beach	Person on Beach	Person on Beach	Person on Beach Surfer Dog not on Leash	Person on Beach
Medium (0.01-0.9 per km)	Bather Fishing Surfer Kayaker Boogie Boarder Dog not on Leash	Surfer Kayaker Other Person Fishing Bather Clam Digger Dog not on Leash Kite Surfer Boogie Boarder Dog on Leash	Horseback Rider Surfer Kayaker Fishing Dog not on Leash Bather	Dog on Leash Fishing Kayaker Camper Bather Clam Digger Boogie Boarder Other Person Biker Boater	Fishing Dog not on Leash Boater Other Person Kayaker Scuba Diver Camper Dog on Leash Bather
Low (0.001-0.009 per km)	Other Person Boater Dog on Leash Camper Skim Boarder Biker Hang-glider Kite Flyer Kite Surfer	Biker Kite Flyer Boater Skim Boarder Wind Surfer Vehicle	Dog on Leash Wind Surfer Kite Surfer Boater Boogie Boarder Biker Camper Skim Boarder Scuba Diver	Skim Boarder Vehicle Horseback Rider Kite Flyer Wind Surfer	Biker

Table 7 (continued). Human use occurrence by MPA. High, moderate, low, and no occurrence based on cumulative encounter rates (#/km): 1994-2013. Zero encounters are not presented here.

Montara SMR Fitzgerald Marine Reserve, Entrance	Montara SMR Fitzgerald Marine Reserve, Distillery	Montara SMR Fitzgerald Marine Reserve, Frenchman's Reef	Año Nuevo SMCA North Point	Año Nuevo SMCA Cove Beach	Año Nuevo SMCA Bradley
Person on Beach	Person on Beach	Person on Beach	Person on Beach	Person on Beach Surfer	Person on Beach
Fishing	Fishing	Surfer	Other Person	Bather	Dog not on Leash
Boater	Dog not on Leash	Dog not on Leash	Horseback Rider	Boogie Boarder	Camper
Dog not on Leash	Surfer	Fishing	Surfer	Dog on Leash	Other Person
Other Person	Kayaker	Boater		Dog not on Leash	Fishing
Boogie Boarder	Scuba Diver	Kayaker		Fishing	Dog on Leash
Dog on Leash	Boater	Dog on Leash		Kayaker	Bather
Kayaker		Other Person		Vehicle	Vehicle
Kite Flyer		Camper			
		Boogie Boarder			
		Vehicle			
Scuba Diver	Jet Skier	Bather	Dog not on Leash	Boater	ATV Rider
Bather	Dog on Leash	Para-glider	Boater	ATV Rider	Boogie Boarder
Skim Boarder		Scuba Diver			Kayaker
		Kite Flyer			Surfer
		Kite Surfer			Boater
					Kite Surfer
					Skim Boarder
					Wind Surfer
					Biker
					Kite Flyer

3.0 Conclusion and Recommendations for Long-term monitoring

Beach Watch data, spanning almost 20 years, provides an assessment of status and trends of species of interest and human activities on beaches within and adjacent to the NCC MPAs. Note that Beach Watch data do not reveal population trends but may reflect high productivity and capture mortality events and trends. These data also provide a regional overview of the health of the ecosystem and within individual MPAs. Viewing Beach Watch trend data throughout the region, using reference beaches as baseline, gives context of trends and changes within an MPA. Variability exists in this ever changing region due to environmental changes, human-uses and wildlife disturbance, and due to regulatory and management actions. Assumptions of normal patterns in our coastal ecosystems are in question, therefore understanding the baseline levels and trends of live and dead birds and mammals are essential to gauging the health of the NCC MPAs.

Appropriate Use of Beach Watch Data

Shoreline data collected through volunteer citizen science programs provide valuable data, as well as instill in the public a sense of stewardship and increased protection of marine and coastal areas, while providing cost-effective, long-term monitoring programs. Beach Watch data provides many opportunities for future analysis and understanding, but as with any data set it is important to understand appropriate use of the data.

Likelihood of dead bird and mammal documentation is affected by a variety of factors, including: the location of mortality, likelihood of deposition, likelihood of detection (size of animal and retention of any identifiable part that can be observed during a survey) and species. Currents, wind, swell and beach exposure all influence likelihood of transport to the beach, and likelihood of deposition depending the orientation and characteristics of the beach. Width of beach, substrate, quantity of beach wrack and amount of sand deposition all play roles in detection of carcasses by surveyors. Surveyor effort, skill and training also affect detection rates. Lastly, there is variation in deposition and detection depending on the size of the animal. Smaller species such as Storm-Petrels and smaller shorebirds are rarely recovered on beach surveys. Very small birds are more difficult to detect among beach wrack. The likelihood that a very small bird is consumed whole is high, where the inedible remains of larger animals are left on the beach and available for documentation (Van Pelt 1995). Beach Watch data is not suited to speak to dead encounter of species like Snowy Plovers or Western Sandpipers because they are too small. That data is not shown here for this reason.

Beach Watch surveys beaches that allow safe access to surveyors at a variety of tides. This limits the diversity of habitats covered to primarily sandy beaches with a small proportion of cobble or rocky coast (Roletto 2012). We have limited data for species found primarily in those habitats, In addition, all other habitats are not significantly represented in our data. As a result, Beach Watch data is best suited for sandy beach characterization.

Some species of marine mammals such as otters, fur seals and cetaceans, are observed live in very low numbers and thus the data are not robust enough for trend data. Sometimes dead marine mammal specimens, e.g. small and rare species, are removed from our survey beaches by the Marine Mammal Stranding Network (MMSN) prior to being documented by Beach Watch (Flannery M pers com). These data are available and may be incorporated for future analyses.

Analysis of stochastic events such as oil spills, oceanic and climactic oscillations, and variation in prey availability are outside of the scope of this analysis. But understanding their impact on encounter rates and trends may be important to future management of MPAs. Collaboration and further inquiry into the causes of these trends is recommended. Other Beach Watch data could be utilized to gain a broader and deeper understanding of our survey region; including seasonal trends, varying demographics of mortality, and spatial analysis of dead deposition in relation to MPAs using geo-referenced dead deposition, chronic and acute oil impacts on MPAs.

Recommendations for Long-term Monitoring

Ongoing Monitoring within the North Central Coast - Recommended Parameters
We recommend continued monitoring of live and dead birds and mammals and human-uses throughout the NCC region. Distribution patterns show highest encounter rates of live wildlife on beaches along bays and promontories and MPAs than at the remaining reference sites. Long-term

monitoring resources are always limited, with that in mind we have selected 17 reference beaches with high wildlife or are immediately adjacent to MPAs that can be used to track trends and divergence in MPA and reference cites into the future (Table 8). We recommend continued monitoring for live and dead wildlife and human uses at these 28 key beaches (11 inside MPAs and 17 outside MPAs) identified in this report that have proven importance to wildlife species of interest, to track potential divergence over time since implementation increases.

Table 8. Recommended key beaches for long-term monitoring of NCC MPAs. Beaches in bold are MPAs, beaches with* are immediately adjacent to MPAs, all others have high encounter rates for wildlife and specific species of interest.

Doran Beach*	Baker Beach
Pinnacle Gulch*	Land's End
Brazil Beach	Ocean Beach North
Point Reyes Beach A	Ocean Beach Central
Point Reyes Beach B	**Fitzgerald Marine Reserve, Weinke Way**
Drakes Beach West	**Fitzgerald Marine Reserve, Entrance**
Drakes Beach East	**Fitzgerald Marine Reserve, Distillery**
Limantour Beach West	**Fitzgerald Marine Reserve, Frenchman's Reef**
Limantour Beach East*	Pillar Point/Maverick's*
Bolinas Beach	Half Moon Bay, Frances Beach
Bolinas Lagoon, Dipsea Road	Pescadero Beach
Seadrift*	Gazos Creek
Rodeo Beach	**North Point**
Kirby Cove	**Cove Beach**

Common Species Monitoring Inform Specific Species of Interest Monitoring
We recommend utilizing common species as indicators of ecosystem health and as surrogates for less common or less detectable species of concern. Consider identifying surrogates for species such as Marbled Murrelets, Surfbirds and Steller Sea Lion, species that are rarely documented on surveys due to species coastal use and habitat preferences that do not overlap greatly with Beach Watch survey beaches. We recommend consideration of the species habitat requirements, including time of year, habitat types, as well as prey base to help determine a species or suite of species that could serve as surrogate for that particular species of interest. Good surrogate species would be those that share habitat requirements, are ubiquitous throughout the area of interest, where many observations can be collected from a shore-based community-based research source such as Beach Watch. Using species such as Western Gull, Common Murre, Brandt's Cormorants, California Sea Lion or Harbor Seal provide large sample size year-round.

Expansion of Consistent Methodologies Throughout the North Central Coast
Currently Beach Watch covers only the southern portion of the NCC region, with the northern most survey at Bodega Bay. We recommend adding survey beaches along the Sonoma and Mendocino Counties, so that the entire NCC region would be surveyed under consistent methodologies. Gulf of the Farallones National Marine Sanctuary expansion is expected within the next several years, thus

making expansion of Beach Watch shoreline monitoring a natural next step. The Sanctuary expansion will increase the use of citizen-scientists throughout the North-Central MPAs.

Recommended Future Analyses of Beach Watch Data
At present we do not recommend comparison of pre and post MPA implementation as implementation occurred so recently. High annual variability of encounters combined with short samples size of implementation years would not provide strong analysis at this time. However we do recommend comparison of before MPA implementation and after MPA implementation encounter rates in 2020 after 10 years have passed. We recommend future analyses of the relationship between human use activities and wildlife presence. Species of specific interest such as Snowy Plovers or Willets and human uses such as people on beach, dogs and unleashed dogs could shed some light on patterns of distribution and declines respectively. We also recommend further inquiry into Marine Mammal stranding rates through inclusion of data, by members of the Marine Mammal Stranding Network. And lastly we recommend analyses to identify comparable reference beaches, i.e. length, substrate, exposure, habitat, and species suite for site specific comparisons of treatment vs. reference over time.

Ongoing Support of Citizen Science Monitoring within the North Central Coast
And finally we recommend the continued utilization and support of citizen science monitoring, as a cost effective strategy for sustainable long-term high-quality monitoring of regional natural resources within and outside of MPAs. Citizen Science serves an important role in MPA monitoring, beyond providing scientific data. The 130 or more volunteers participating in Beach Watch are ambassadors conducting regular community outreach on urban and remote regions of our coast. Their activities promote stewardship and engagement that leads to increased marine resource protection. In the future these citizen scientists can be trained to document MPA violations and develop protocols for reporting violations.

Beach Watch data, although spanning almost 20 years, provides but a "snapshot" of the North Central Coast of California wildlife and human uses in pre and early MPA implementation. We live in a time where past assumptions of "normal" patterns in our coastal ecosystems are being challenged while new protection paradigms are put in place. Understanding changes in status and trends of live and dead birds and mammals in coming years will be essential to gauging the health of the North Central Coast of California.

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Appendices

Appendix A. North Central Coast Marine Protected Area Map. Año Nuevo SMCA is part of the Central Coast MPA region, and therefore not included on this map. Data for Año Nuevo SMCA are included in this report.
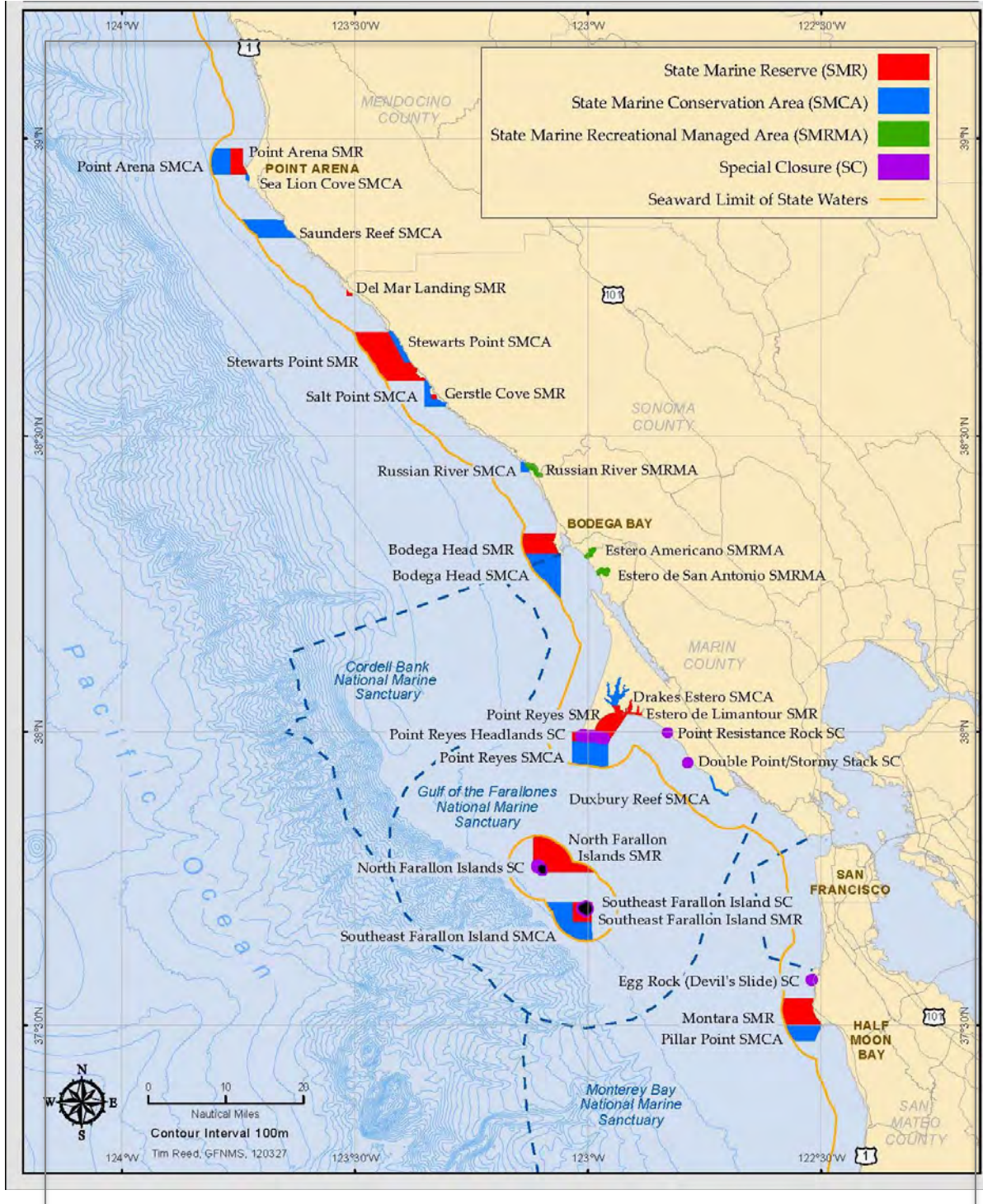
Appendix B. Beach Watch Survey Sites. Survey beaches are listed from north to south. Survey length in kilometers and MPA status are provided. Reference sites that are immediately adjacent to an MPA are noted with an asterisk. Survey sites within MPA's are noted in bold.

Survey Name	Survey length (km)	Status
Doran Beach	3.25	reference
Pinnacle Gulch	2.42	reference*
Dillon Beach	2.92	reference
Brazil Beach	3.76	reference
Tomasini Creek Beach	5	reference
Point Reyes Beach A	4.91	reference
Point Reyes Beach B	4.91	reference
Point Reyes Beach C	3.59	reference
Drakes Beach West	**4.11**	**Point Reyes SMR**
Drakes Beach East	**2.53**	**Point Reyes SMR**
Limantour Beach West	**4.62**	**Point Reyes SMR**
Limantour Beach East	2.59	reference*
Bolinas Beach	**5.24**	**Duxbury Reef SMCA**
Bolinas Lagoon, Dipsea Road	2.64	reference*
Seadrift	3.19	reference*
Muir Beach	0.63	reference
Rodeo Beach	1.07	reference
Kirby Cove	0.32	reference
Baker Beach	1.21	reference
China Beach	0.32	reference
Land's End	0.15	reference
Ocean Beach North	1.61	reference
Ocean Beach Central	3.22	reference
Ocean Beach South	0.93	reference
Thornton Beach North	3.03	reference
Sharp Park	1.41	reference
South Montara Beach	1.25	reference
Fitzgerald Marine Reserve, Weinke Way	**0.71**	**Montara SMR**
Fitzgerald Marine Reserve, Entrance	**0.9**	**Montara SMR**
Fitzgerald Marine Reserve, Distillery	**1.26**	**Montara SMR**
Fitzgerald Marine Reserve, Frenchman's Reef	**1.37**	**Montara SMR**
Pillar Point/Maverick's	0.39	reference*
Half Moon Bay, Naples Beach	1.04	reference
Half Moon Bay, Frances Beach	1.51	reference
Pomponio Headlands	2.37	reference
Pescadero Beach	1	reference
Pebble Beach	2.7	reference

Gazos Creek	3.19	reference	
North Point	**1.57**	**Año Nuevo SMCA**	
Cove Beach	**0.91**	**Año Nuevo SMCA**	
Bradley Beach	**1.62**	**Año Nuevo SMCA**	

Appendix C. Beach Watch Survey Effort, total surveys, live and dead kilometers surveyed from 1994-2012. Beaches in bold text are within a NCC MPA.

Survey Name	Live km Surveyed	Dead km Surveyed	Total Surveys
Doran Beach	1406.34	1406.02	446
Pinnacle Gulch	473.11	473.11	223
Dillon Beach	1202.16	1201.87	420
Brazil Beach	1016.14	1015.76	307
Tomasini Creek Beach	1531.9	1530.4	357
Point Reyes Beach A	2110.32	2110.32	477
Point Reyes Beach B	1988.01	1972.3	450
Point Reyes Beach C	934.12	936.99	268
Drakes Beach West	**1604.83**	**1600.52**	**476**
Drakes Beach East	**908.6**	**913.41**	**401**
Limantour Beach West	**2181.61**	**2175.84**	**504**
Limantour Beach East	915.33	917.79	385
Bolinas Beach	**997.96**	**985.38**	**220**
Bolinas Lagoon, Dipsea Road	588.72	590.57	229
Seadrift	700.68	699.73	255
Muir Beach	281.64	280.79	468
Rodeo Beach	494.29	492.84	507
Kirby Cove	102.58	101.55	346
Baker Beach	506.08	505.78	446
China Beach	98.23	97.85	325
Land's End	41.99	41.71	296
Ocean Beach North	327.72	324.5	220
Ocean Beach Central	1219.9	1242.12	407
Ocean Beach South	264.52	259.13	300
Thornton Beach North	891.3	886.91	382
Sharp Park	548.56	547.86	401
South Montara Beach	462.64	462.64	394
Fitzgerald Marine Reserve, Weinke Way	**190.46**	**191.17**	**306**
Fitzgerald Marine Reserve, Entrance	**247.86**	**247.23**	**314**
Fitzgerald Marine Reserve, Distillery	**326.65**	**326.91**	**292**
Fitzgerald Marine Reserve, Frenchman's Reef	**373.46**	**372.85**	**301**
Pillar Point/Maverick's	105.32	105.32	277

Half Moon Bay, Naples Beach	335.3	335.24	333
Half Moon Bay, Frances Beach	469.69	462.74	336
Pomponio Headlands	651.7	651.47	302
Pescadero Beach	450.95	450.9	459
Pebble Beach	633.69	627.62	291
Gazos Creek	1208.85	1207.89	449
North Point	**421.7**	**421**	**303**
Cove Beach	**221.77**	**221.77**	**254**
Bradley Beach	**477.82**	**477.74**	**316**
Total effort		59,788 km surveyed	14,443 surveys
MPA effort		15,886 km surveyed	3,687 surveys

Appendix D. All taxon documented by Beach Watch, including scientific name, and regional occurrence status. Residents are present all year and breed in the region. Wintering birds are migrants that use the NCC region in winter months. Summering birds are migrants that use the NCC region in the summer months.

ALL BIRDS		
Common Name	**Scientific Name**	**Status**
Red-throated Loon	*Gavia stellata*	Winter
Pacific Loon	*Gavia pacifica*	Winter
Common Loon	*Gavia immer*	Winter
Yellow-billed Loon	*Gavia adamsii*	Winter
Loon (unidentified)	*Gavia*	Winter
Pied-billed Grebe	*Podilymbus podiceps*	Winter
Horned Grebe	*Podiceps auritus*	Winter
Red-necked Grebe	*Podiceps grisegena*	Winter
Eared Grebe	*Podiceps nigricollis*	Winter
Eared/Horned Grebe	*Podiceps auritus/nigricol.*	Winter
Western Grebe	*Aechmophorus occidentalis*	Winter
Clark's Grebe	*Aechmophorus clarkii*	Winter
Western/Clark's Grebe	*Aechmophorus occident./clarkii*	Winter
Grebe (unidentified)	*Podicipedidae*	Winter
Black-footed Albatross	*Phoebastria nigripes*	Resident
Laysan Albatross	*Phoebastria immutabilis*	Resident
Northern Fulmar	*Fulmarus glacialis*	Winter
Pink-footed Shearwater	*Puffinus creatopus*	Summer
Flesh-footed Shearwater	*Puffinus carneipes*	Winter
Buller's Shearwater	*Puffinus bulleri*	Summer
Sooty Shearwater	*Puffinus griseus*	Summer
Short-tailed Shearwater	*Puffinus tenuirostris*	Summer
Sooty/Short-tailed Shearwater	*Puffinus griseus/tentuiro.*	Summer
Manx Shearwater	*Puffinus puffinus*	Resident
Black-vented Shearwater	*Puffinus opisthomelas*	Summer
Fork-tailed Storm-Petrel	*Oceanodroma furcata*	Winter

Leach's Storm-Petrel	*Oceanodroma leucorhoa*	Resident
Ashy Storm-Petrel	*Oceanodroma homochroa*	Resident
American White Pelican	*Pelecanus erythrorhynchos*	Summer
Brown Pelican	*Pelecanus occidentalis*	Summer
Brandt's Cormorant	*Phalacrocorax penicillatus*	Resident
Double-crested Cormorant	*Phalacrocorax auritus*	Resident
Pelagic Cormorant	*Phalacrocorax pelagicus*	Resident
Cormorant (unidenitfied)	*Phalacrocorax*	Resident
Great Blue Heron	*Ardea herodias*	Resident
Great Egret	*Ardea alba*	Resident
Snowy Egret	*Egretta thula*	Resident
Green Heron	*Butorides virescens*	Summer
Brown Booby	*Sula leucogaster*	Unknown
Black-crowned Night-Heron	*Nycticorax nycticorax*	Resident
Turkey Vulture	*Cathartes aura*	Resident
Greater White-fronted Goose	*Anser albifrons*	Winter
Ross's Goose	*Chen rossii*	Winter
Canada Goose	*Branta canadensis*	Resident
Cackling Goose	*Branta hutchinsii*	Migrant
Brant	*Branta bernicla*	Winter
Snow Goose	*Chen caerulescens*	Migrant
Tundra Swan	*Cygnus columbianus*	Winter
Mute Swan	*Cygnus olor*	Migrant
Gadwall	*Anas strepera*	Winter
Eurasian Wigeon	*Anas penelope*	Winter
American Wigeon	*Anas americana*	Winter
Mallard	*Anas platyrhynchos*	Resident
Cinnamon Teal	*Anas cyanoptera*	Summer
Northern Shoveler	*Anas clypeata*	Winter
Northern Pintail	*Anas acuta*	Winter
Green-winged Teal	*Anas c. carolinensis*	Winter
Canvasback	*Aythya valisineria*	Winter
Ring-necked Duck	*Aythya collaris*	Winter
Greater Scaup	*Aythya marila*	Winter
Lesser Scaup	*Aythya affinis*	Winter
King Eider	*Somateria spectabilis*	Winter
Harlequin Duck	*Histrionicus histrionicus*	Winter
Surf Scoter	*Melanitta perspicillata*	Winter
White-winged Scoter	*Melanitta fusca*	Winter
Black Scoter	*Melanitta americana*	Winter
Duck (unidentified)	*Aves*	Resident
Scoter (unidentified)	*Melanitta*	Winter
Long-tailed Duck	*Clangula hyemalis*	Winter
Bufflehead	*Bucephala albeola*	Winter
Common Goldeneye	*Bucephala clangula*	Winter
Barrow's Goldeneye	*Bucephala islandica*	Winter
Hooded Merganser	*Lophodytes cucullatus*	Winter

Common Merganser	*Mergus merganser*	Winter
Red-breasted Merganser	*Mergus serrator*	Winter
Ruddy Duck	*Oxyura jamaicensis*	Resident
Osprey	*Pandion haliaetus*	Summer
White-tailed Kite	*Elanus leucurus*	Resident
Northern Harrier	*Circus cyaneus*	Winter
Sharp-shinned Hawk	*Accipiter striatus*	Winter
Cooper's Hawk	*Accipiter cooperii*	Resident
Red-shouldered Hawk	*Buteo lineatus*	Resident
Swainson's Hawk	*Buteo swainsoni*	Migrant
Red-tailed Hawk	*Buteo jamaicensis*	Resident
Ferruginous Hawk	*Buteo regalis*	Winter
Rough-legged Hawk	*Buteo lagopus*	Winter
Golden Eagle	*Aquila chrysaetos*	Winter
Bald Eagle	*Haliaeetus leucocephalus*	Migrant
American Kestrel	*Falco sparverius*	Resident
Merlin	*Falco columbarius*	Winter
Peregrine Falcon	*Falco peregrinus*	Resident
Raptor (unidentified)	*Falconiformes*	Resident
Red Junglefowl	*Gallus gallus*	Resident
California Quail	*Callipepla californica*	Resident
Wild Turkey	*Meleagris gallopavo*	Resident
Virginia Rail	*Rallus limicola*	Resident
Sora	*Porzana carolina*	Resident
American Coot	*Fulica americana*	Resident
Black-bellied Plover	*Pluvialis squatarola*	Winter
Pacific Golden-Plover	*Pluvialis fulva*	Migrant
Snowy Plover	*Charadrius nivosus*	Resident
Semipalmated Plover	*Charadrius semipalmatus*	Winter
Killdeer	*Charadrius vociferus*	Resident
Black Oystercatcher	*Haematopus bachmani*	Resident
American Avocet	*Recurvirostra americana*	Winter
Black-necked Stilt	*Himantopus mexicanus*	Migrant
Greater Yellowlegs	*Tringa melanoleuca*	Winter
Lesser Yellowlegs	*Tringa flavipes*	Migrant
Willet	*Tringa semipalmata*	Winter
Wandering Tattler	*Tringa incana*	Migrant
Spotted Sandpiper	*Actitis macularius*	Migrant
Whimbrel	*Numenius phaeopus*	Winter
Long-billed Curlew	*Numenius americanus*	Winter
Marbled Godwit	*Limosa fedoa*	Winter
Ruddy Turnstone	*Arenaria interpres*	Winter
Black Turnstone	*Arenaria melanocephala*	Winter
Surfbird	*Aphriza virgata*	Migrant
Red Knot	*Calidris canutus*	Migrant
Sanderling	*Calidris alba*	Winter
Western Sandpiper	*Calidris mauri*	Winter

Least Sandpiper	*Calidris minutilla*	Winter
Baird's Sandpiper	*Calidris bairdii*	Migrant
Pectoral Sandpiper	*Calidris melanotos*	Migrant
Ruff	*Philomachus pugnax*	Migrant
Dunlin	*Calidris alpina*	Winter
Small Shorebird (unidentified)	*Calidris*	Winter
Short-billed Dowitcher	*Limnodromus griseus*	Migrant
Long-billed Dowitcher	*Limnodromus scolopaceus*	Winter
Wilson's Snipe	*Gallinago delicata*	Winter
Wilson's Phalarope	*Phalaropus tricolor*	Migrant
Red-necked Phalarope	*Phalaropus lobatus*	Migrant
Red Phalarope	*Phalaropus fulicarius*	Migrant
Phalarope (unidentified)	*Phalaropus*	Migrant
Large Shorebird (unidentified)	*Charadriiformes*	Winter
Pomarine Jaeger	*Stercorarius pomarinus*	Migrant
Parasitic Jaeger	*Stercorarius parasiticus*	Migrant
Laughing Gull	*Leucophaeus atricilla*	Migrant
Franklin's Gull	*Leucophaeus pipixcan*	Migrant
Bonaparte's Gull	*Chroicocephalus philadelphia*	Migrant
Heermann's Gull	*Larus heermanni*	Summer
Mew Gull	*Larus canus*	Winter
Ring-billed Gull	*Larus delawarensis*	Resident
California Gull	*Larus californicus*	Resident
Herring Gull	*Larus argentatus*	Winter
Herring x Glaucous-winged Hybrid	*Larus argetatus x glaucescens*	Winter
Thayer's Gull	*Larus thayeri*	Winter
Western Gull	*Larus occidentalis*	Resident
Western X Glaucous-winged Gull Hybrid	*Larus occid. x gluaces.*	Winter
Glaucous-winged Gull	*Larus glaucescens*	Winter
Glaucous Gull	*Larus hyperboreus*	Winter
Sabine's Gull	*Xema sabini*	Migrant
Black-legged Kittiwake	*Rissa tridactyla*	Winter
Gull (unidentified)	*Larus*	Resident
Caspian Tern	*Hydroprogne caspia*	Summer
Elegant Tern	*Thalasseus elegans*	Summer
Common Tern	*Sterna hirundo*	Migrant
Arctic Tern	*Sterna paradisaea*	Migrant
Forster's Tern	*Sterna forsteri*	Resident
Least Tern	*Sternula antillarum*	Summer
Tern (unidentified)	*Sterna*	Resident
Black Skimmer	*Rynchops niger*	Rare
Common Murre	*Uria aalge*	Resident
Thick-billed Murre	*Uria lomvia*	Migrant
Pigeon Guillemot	*Cepphus columba*	Summer
Marbled Murrelet	*Brachyramphus marmoratus*	Winter
Murrelet (unidentified)	*Synthliboramphus*	Summer
Craveri's Murrelet	*Synthliboramphus craveri*	Summer

Ancient Murrelet	*Synthliboramphus antiquus*	Winter
Cassin's Auklet	*Ptychoramphus aleuticus*	Resident
Parakeet Auklet	*Aethia psittacula*	Winter
Rhinoceros Auklet	*Cerorhinca monocerata*	Resident
Horned Puffin	*Fratercula corniculata*	Winter
Tufted Puffin	*Fratercula cirrhata*	Resident
Alcid (unidentified)	*Alicdae*	Resident
Eurasian Collared-Dove	*Streptopelia decaocto*	Migrant
Rock Pigeon	*Columba livia*	Resident
Band-tailed Pigeon	*Patagioenas fasciata*	Resident
Mourning Dove	*Zenaida macroura*	Resident
Prairie Falcon	*Falco mexicanus*	Migrant
Barn Owl	*Tyto alba*	Resident
Great Horned Owl	*Bubo virginianus*	Resident
Short-eared Owl	*Asio flammeus*	Winter
Long-eared Owl	*Asio otus*	Winter
Vaux's Swift	*Chaetura vauxi*	Summer
Black Swift	*Cypseloides niger*	Migrant
White-throated Swift	*Aeronautes saxatalis*	Resident
Anna's Hummingbird	*Calypte anna*	Resident
Allen's Hummingbird	*Selasphorus sasin*	Summer
Belted Kingfisher	*Megaceryle alcyon*	Resident
Red-breasted Sapsucker	*Sphyrapicus ruber*	Resident
Acorn Woodpecker	*Melanerpes formicivorus*	Resident
Downy Woodpecker	*Picoides pubescens*	Resident
Nuttall's Woodpecker	*Picoides nuttallii*	Resident
Northern Flicker	*Colaptes auratus*	Resident
Hairy Woodpecker	*Picoides villosus*	Resident
Pacific-slope Flycatcher	*Empidonax difficilis*	Summer
Black Phoebe	*Sayornis nigricans*	Resident
Say's Phoebe	*Sayornis saya*	Winter
Ash-throated Flycatcher	*Myiarchus cinerascens*	Resident
Western Kingbird	*Tyrannus verticalis*	Migrant
Loggerhead Shrike	*Lanius ludovicianus*	Winter
Hutton's Vireo	*Vireo huttoni*	Resident
Warbling Vireo	*Vireo gilvus*	Summer
Steller's Jay	*Cyanocitta stelleri*	Resident
Yellow-billed Magpie	*Pica nuttalli*	Resident
Western Scrub-Jay	*Aphelocoma californica*	Resident
Clark's Nutcracker	*Nucifraga columbiana*	Winter
American Crow	*Corvus brachyrhynchos*	Resident
Common Raven	*Corvus corax*	Resident
American Crow/Common Raven	*Corvus brachyrhyn./corax*	Resident
Horned Lark	*Eremophila alpestris*	Resident
Purple Martin	*Progne subis*	Summer
Swallow (unidentified)	*Aves*	Resident
Tree Swallow	*Tachycineta bicolor*	Summer

Violet-green Swallow	*Tachycineta thalassina*	Migrant
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	Summer
Bank Swallow	*Riparia riparia*	Summer
Cliff Swallow	*Petrochelidon pyrrhonota*	Summer
Barn Swallow	*Hirundo rustica*	Summer
Chestnut-backed Chickadee	*Poecile rufescens*	Resident
Bushtit	*Psaltriparus minimus*	Resident
Rock Wren	*Salpinctes obsoletus*	Resident
Pygmy Nuthatch	*Sitta pygmaea*	Resident
Red-breasted Nuthatch	*Sitta canadensis*	Resident
Bewick's Wren	*Thryomanes bewickii*	Resident
House Wren	*Troglodytes aedon*	Resident
Marsh Wren	*Cistothorus palustris*	Resident
Pacific Wren	*Troglodytes pacificus*	Resident
Golden-crowned Kinglet	*Regulus satrapa*	Winter
Ruby-crowned Kinglet	*Regulus calendula*	Winter
Blue-gray Gnatcatcher	*Polioptila caerulea*	Winter
Western Bluebird	*Sialia mexicana*	Resident
Swainson's Thrush	*Catharus ustulatus*	Summer
Hermit Thrush	*Catharus guttatus*	Winter
Varied Thrush	*Ixoreus naevius*	Resident
American Robin	*Turdus migratorius*	Resident
Wrentit	*Chamaea fasciata*	Resident
Northern Mockingbird	*Mimus polyglottos*	Migrant
European Starling	*Sturnus vulgaris*	Resident
American Pipit	*Anthus rubescens*	Winter
Orange-crowned Warbler	*Oreothlypis celata*	Resident
Yellow Warbler	*Setophaga petechia*	Migrant
Yellow-rumped Warbler	*Setophaga coronata*	Winter
Townsend's Warbler	*Setophaga townsendi*	Migrant
Common Yellowthroat	*Geothlypis trichas*	Resident
Wilson's Warbler	*Cardellina pusilla*	Summer
Yellow-breasted Chat	*Icteria virens*	Summer
Spotted Towhee	*Pipilo maculatus*	Resident
California Towhee	*Melozone crissalis*	Resident
Sparrow (unidentified)	*Aves*	Resident
Clay-colored Sparrow	*Spizella pallida*	Migrant
Savannah Sparrow	*Passerculus sandwichensis*	Resident
Fox Sparrow	*Passerella iliaca*	Winter
Song Sparrow	*Melospiza melodia*	Resident
White-throated Sparrow	*Zonotrichia albicollis*	Winter
White-crowned Sparrow	*Zonotrichia leucophrys*	Resident
Golden-crowned Sparrow	*Zonotrichia atricapilla*	Winter
Dark-eyed Junco	*Junco hyemalis*	Winter
Hooded Oriole	*Icterus cucullatus*	Summer
Red-winged Blackbird	*Agelaius phoeniceus*	Resident
Tricolored Blackbird	*Agelaius tricolor*	Winter

Western Meadowlark	*Sturnella neglecta*	Resident
Brewer's Blackbird	*Euphagus cyanocephalus*	Resident
Brown-headed Cowbird	*Molothrus ater*	Summer
Bullock's Oriole	*Icterus bullockii*	Summer
Black-headed Grosbeak	*Pheucticus melanocephalus*	Summer
Purple Finch	*Haemorhous purpureus*	Resident
House Finch	*Haemorhous mexicanus*	Resident
Pine Siskin	*Spinus pinus*	Resident
Lesser Goldfinch	*Spinus psaltria*	Resident
American Goldfinch	*Spinus tristis*	Resident
House Sparrow	*Passer domesticus*	Resident
Bird (unidenitified/non marine)	*Aves*	Resident
Marine Bird (unidentified)	*Aves*	Resident
Bird (unidentified marine/non-marine)	*Aves*	Resident

ALL MAMMALS

Virginia Opossum	*Didelphis virginiana*	Resident
Broad-footed Mole	*Scapanus latimanus*	Resident
Brush Rabbit	*Sylvilagus bachmani*	Resident
Black-tailed Jack Rabbit	*Lepus californicus*	Resident
Sonoma Chipmunk	*Tamias sonomae*	Resident
California Ground Squirrel	*Spermophilus beecheyi*	Resident
Western Gray Squirrel	*Sciurus griseus*	Resident
Western Pocket Gopher	*Thomomys mazama*	Resident
American Beaver	*Castor canadensis*	Winter
Deer/House Mouse	*Peromyscus/Mus manicul./musculus*	Resident
Black/Norway Rat	*Rattus rattus/norvegicus*	Resident
California Vole	*Microtus californicus*	Resident
Common Muskrat	*Ondatra zibethicus*	Resident
Dog (domestic)	*Canis familiaris*	Resident
Coyote	*Canis latrans*	Resident
Gray Fox	*Urocyon cinereoargenteus*	Resident
Northern Fur Seal	*Callorhinus ursinus*	Winter
Guadalupe Fur Seal	*Arctocephalus townsendi*	Summer
Steller Sea Lion	*Eumatopias jubatus*	Resident
California Sea Lion	*Zalophus californianus*	Resident
Otariid (unidentified)	*Otariidae*	Resident
Harbor Seal	*Phoca vitulina*	Resident
Northern Elephant Seal	*Mirounga angustirostris*	Resident
Phocid (unidentified)	*Phocidae*	Resident
Pinniped (unidentified)	*Otariid./Phocid.*	Resident
Ringtail	*Bassariscus astutus*	Resident
Raccoon	*Procyon lotor*	Resident
Long-tailed Weasel	*Mustela frenata*	Resident
Northern River Otter	*Lontra canadensis*	Winter
Sea Otter	*Enhydra lutris*	Resident
Striped Skunk	*Mephitis mephitis*	Resident

Cat (domestic)	*Felis catus*	Resident
Bobcat	*Lynx rufus*	Resident
Gray Whale	*Eschrichtius robustus*	Migrant
Blue Whale	*Balenoptera musculus*	Migrant
Minke Whale	*Balaenoptera acutorostrata*	Summer
Humpback Whale	*Megaptera novaeangliae*	Summer
Sperm Whale	*Physeter macrocephalus*	Resident
Pygmy Sperm Whale	*Kogia breviceps*	Resident
Bottlenose Dolphin	*Tursiops truncatus*	Resident
Cuviers Beaked Whale	*Ziphius Ziphius*	Resident
Pantropical Spotted Dolphin	*Stenella attenuata*	Summer
Striped Dolphin	*Stenella coeruleoalba*	Summer
Common Dolphin (sp.)	*Delphinus delphinus*	Summer
Pacific White-sided Dolphin	*Lagenorhynchus obliquidens*	Resident
Risso's Dolphin	*Grampus griseus*	Resident
Killer Whale	*Orcinus orca*	Resident
Harbor Porpoise	*Phocoena phocoena*	Resident
Dall's Porpoise	*Phocoenoides dalli*	Resident
Cetacean (unidentified)	*Cetacea*	Resident
Marine Mammal (unidentified)	*Mammalia*	Resident
Horse (domestic)	*Equus caballus*	Resident
Northern Right Whale Dolphin	*Lissodelphis borealis*	Unlnown
Wild Pig	*Sus scrofa*	Resident
Elk	*Cervus elaphus*	Resident
Mule Deer	*Odocoileus hemionus*	Resident
Deer (unidentified)	*Cervidae*	Resident
Cow (domestic)	*Bos taurus*	Resident
Sheep (domestic)	*Ammotragus lervia*	Resident
Red Fox	*Vulpes vulpes*	Resident
Mammal (unidentified)	*Mammalia*	Resident
Land Mammal (unidentified)	*Mammalia*	Resident

AMPHIBIANS

Frog (unidentified)	*Ranidae*	Resident

REPTILES

Lizard sp.	*Lguanidae*	Resident
Snake	*Columbridae*	Resident
Leatherback Turtle	*Dermochelys coriacea*	Summer
Pacific Pond Turtle	*Actinemys marmorata*	Resident
Turtle (unidentified)	*Trachemys*	Resident

SHARKS AND RAYS

Salmon Shark	*Lamna ditropis*	Winter
Leopard Shark	*Triakis semifasciata*	Resident
Other Shark	*Chondricthyes*	Resident
Bat Ray	*Myliobatis californica*	Resident

Skate/Ray (unidentified)	*Rajiformes*	Resident
Thresher Shark	*Rafinesque vulpinus*	Unknown
Salmon (unidentified)	*Oncorhynchus*	Winter

FISH

Rockfish (unidentified)	*Sebastes*	Resident
Lingcod	*Ophiodon elongatus*	Resident
Cabezon	*Scorpaenicthys marmoratus*	Resident
Striped Bass	*Morone saxitalis*	Resident
Mola Mola	*Mola mola*	Resident
Marine Fish (unidentified/other)	*Osteichytes*	Resident

OTHER

Animal (unidentified vertebrate)	*Vertebrata*	Resident
Species not in DB	*Unknown Unknown*	Unknown

Appendix E. Beach Watch Human Use Descriptions. Tidepooler was added to the data collection in 2012, therefore not included in this report.

ATV	any motorized vehicle that is not a car or truck
Bather	person wearing bathing suits or wetsuits but have no other gear (i.e. fishing gear)
Biker	person on a bicycle
Boater	any boat under motor or sail power
Boogie boarder	person with boogie board in or out of the water
Camper	person camping on beach
Clam Digger	person clam digging
Dog Leashed	dog on leash
Dog Unleashed	dog off leash
Fishing	people associated with any type of fishing gear
Hang Glider	person hang gliding or with gear
Horseback Rider	person horseback ridding
Jet Skiier	person jet skiing
Kayaker	person with kayak or kayaking
Kite Flyer	person flying a kite
Kite Surfer	person kite surfing or boarding
Other Person	other activity documented by surveyor
Oyster Worker	person working in oyster farm industry
Para Glider	person para-gliding
Person on Beach	person walking, running, picnicking, or playing on the beach
SCUBA diver	person with SCUBA gear
Skim Boarder	person skim boarding or with skim board
Surfer	person in association with a surf board, in or out of the water
Tidepooler*	person on a hard rocky substrate which is exposed at low tide
Vehicle	truck or car
Wind surfer	person wind surfing or with gear

Appendix F. Live and Dead cumulative encounter rate (#/km) by family and beach, 1994-2012
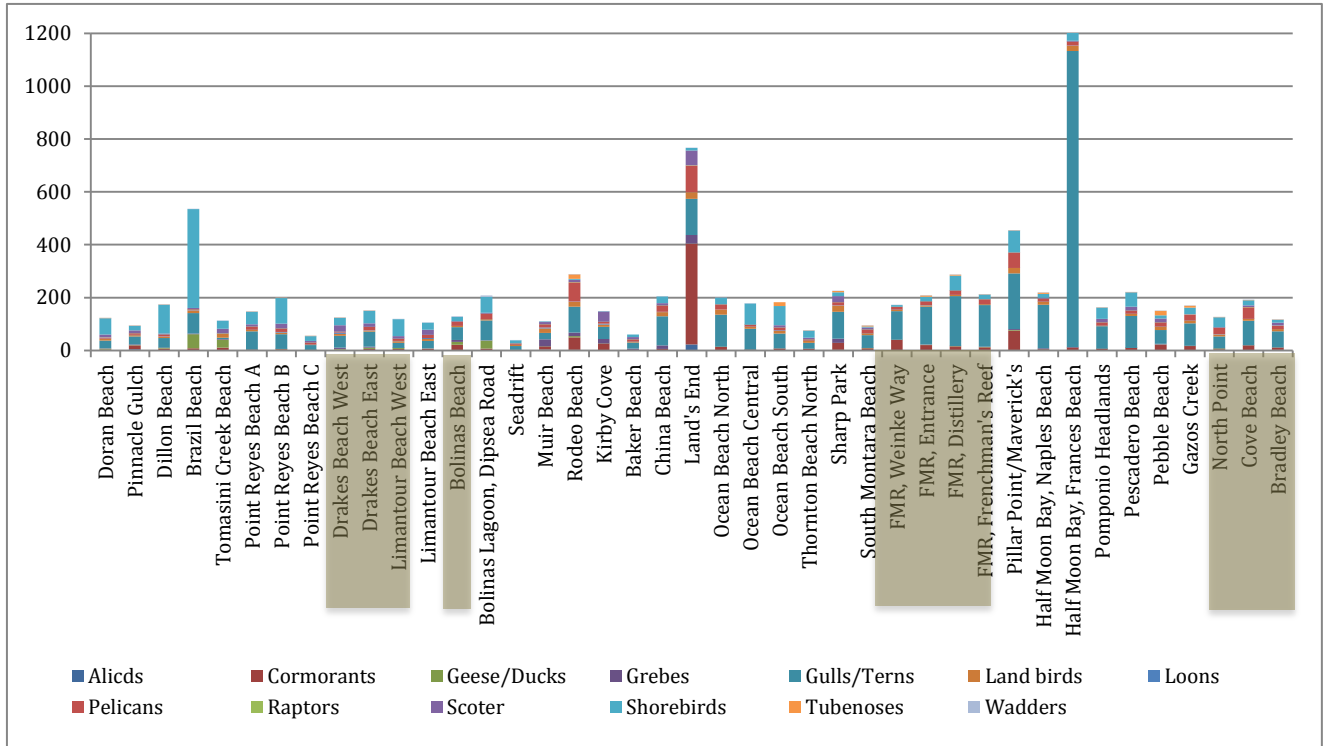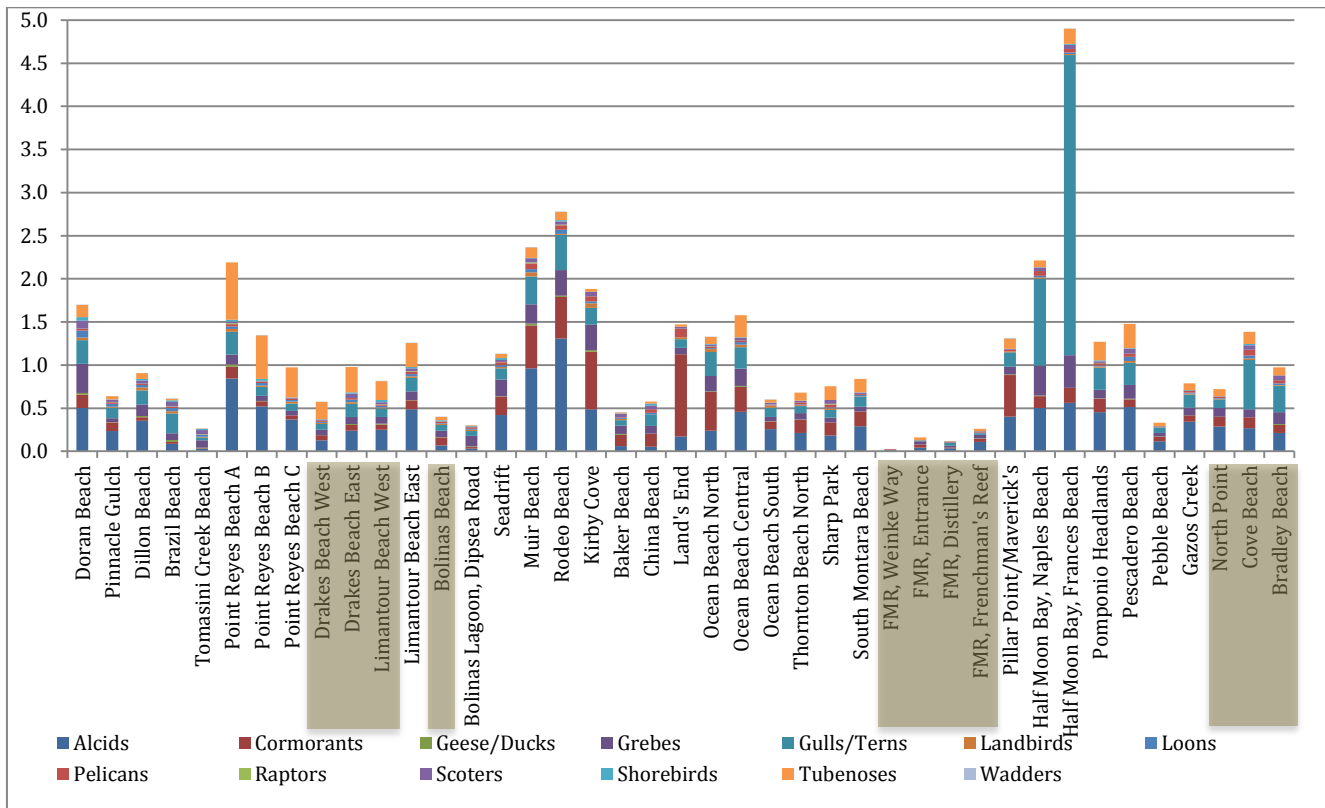

F1. Live bird cumulative encounter rate (#/km) by family and beach, 1994-2012. Beaches within an MPA is shaded in brown.
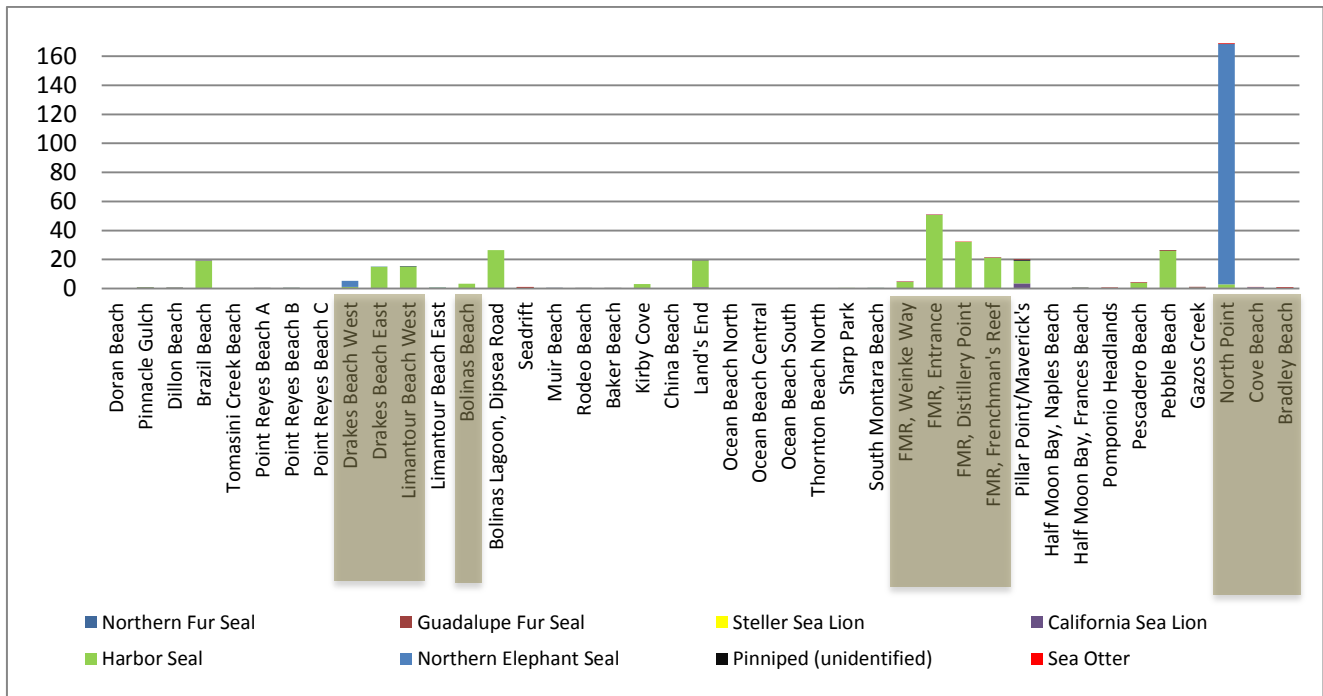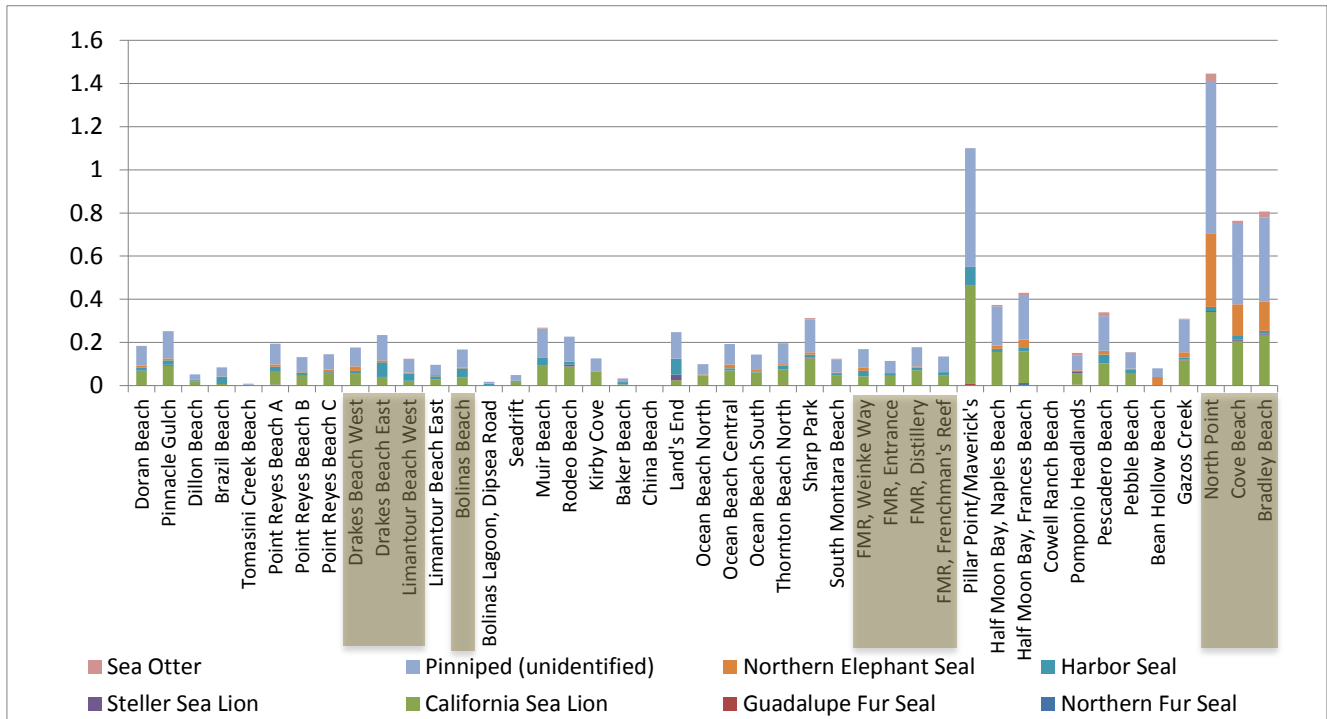

F2. Live pinniped and sea otter cumulative encounter rate (#/km) by family and beach, 1994-2012. Beaches within an MPA is shaded in brown.
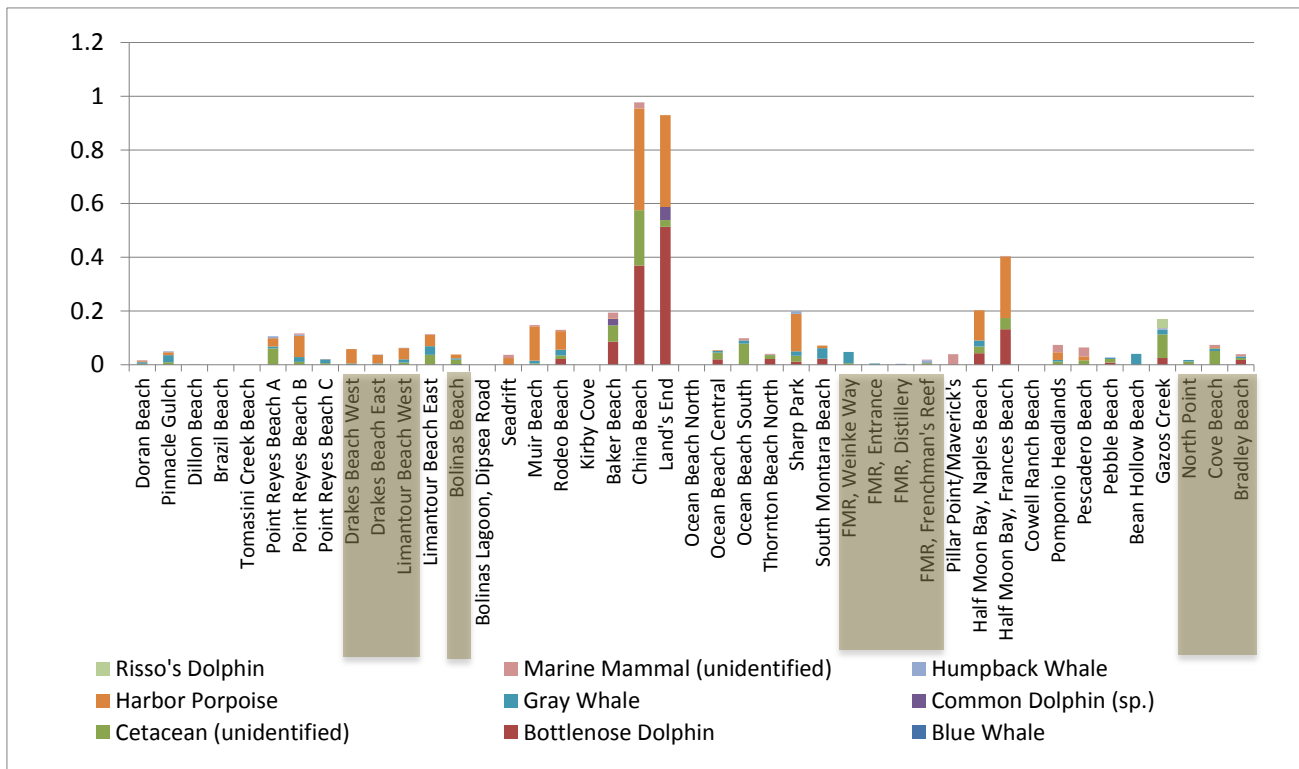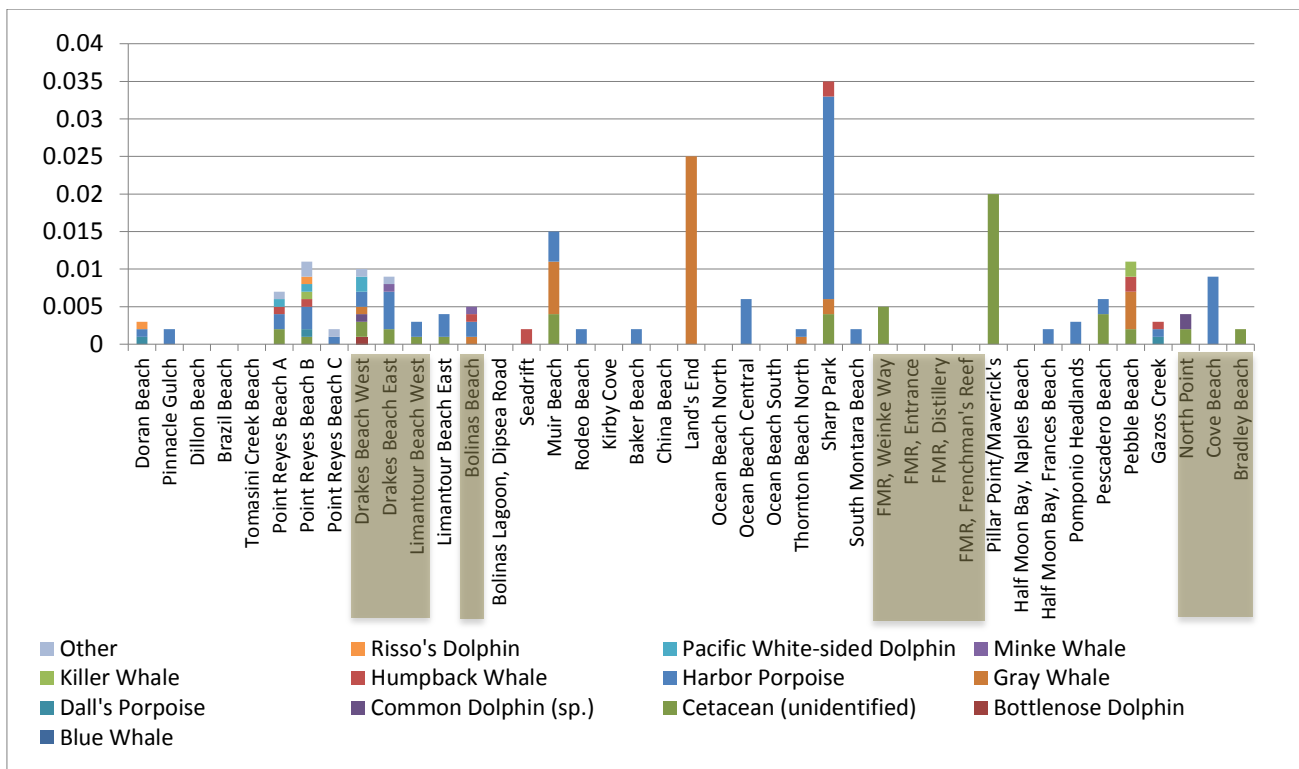
F3. Live cetacean cumulative encounter rate (#/km) by family and beach, 1994-2012. Beaches within an MPA is shaded in brown.

F4. Dead bird cumulative encounter rate (#/km) by family and beach, 1994-2012. Beaches within an MPA is shaded in brown.

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F5. Dead pinniped and otter cumulative encounter rate (#/km) by family and beach, 1994-2012. Beaches within an MPA is shaded in brown.

F6. Dead cetacean cumulative encounter rate (#/km) by family and beach, 1994-2012. Beaches within an MPA is shaded in brown.

Appendix G. Live and Dead Marine Mammal Species Encounter, 1994-2012
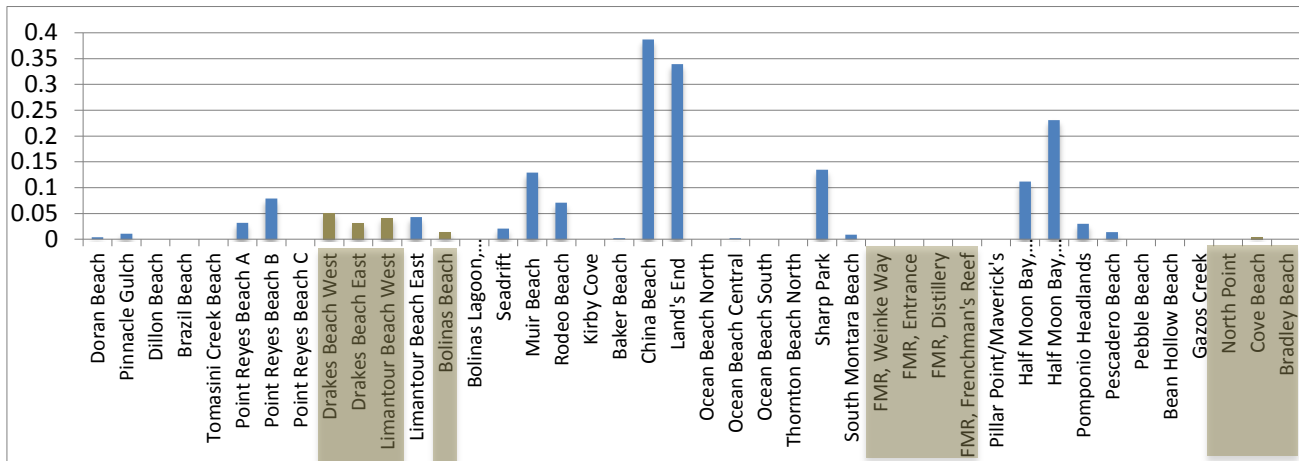
G1. Live Harbor Porpoise encounter rates (#/km), by beach, 1994-2012. Beaches within an MPA is shaded in brown.
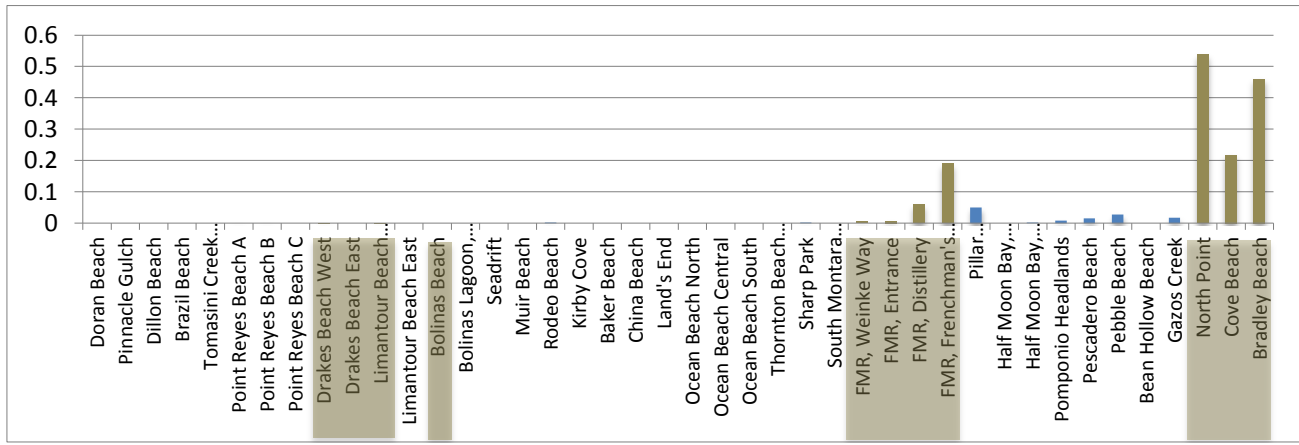
G2. Live Sea Otter encounter rates (#/km), by beach, 1994-2012. Beaches within an MPA is shaded in brown.
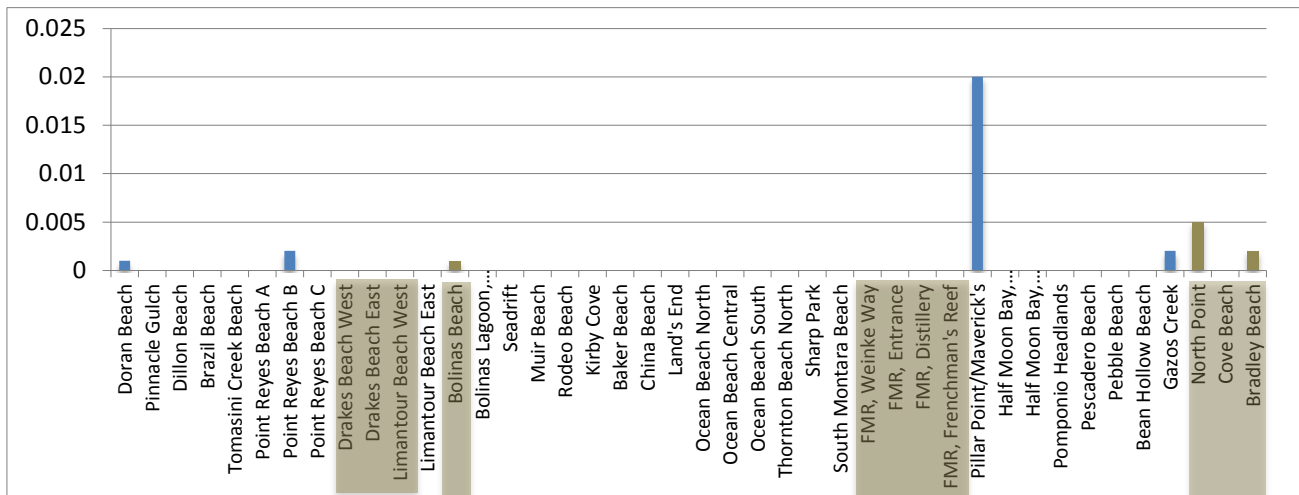
G3. Live Steller Sea Lion encounter rates (#/km), by beach, 1994-2012. Beaches within an MPA is shaded in brown.
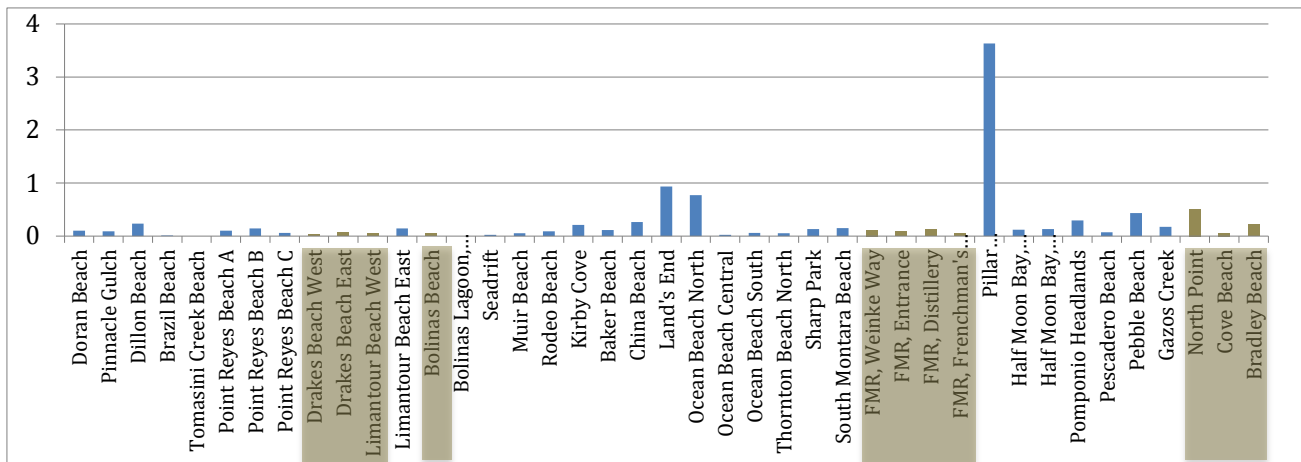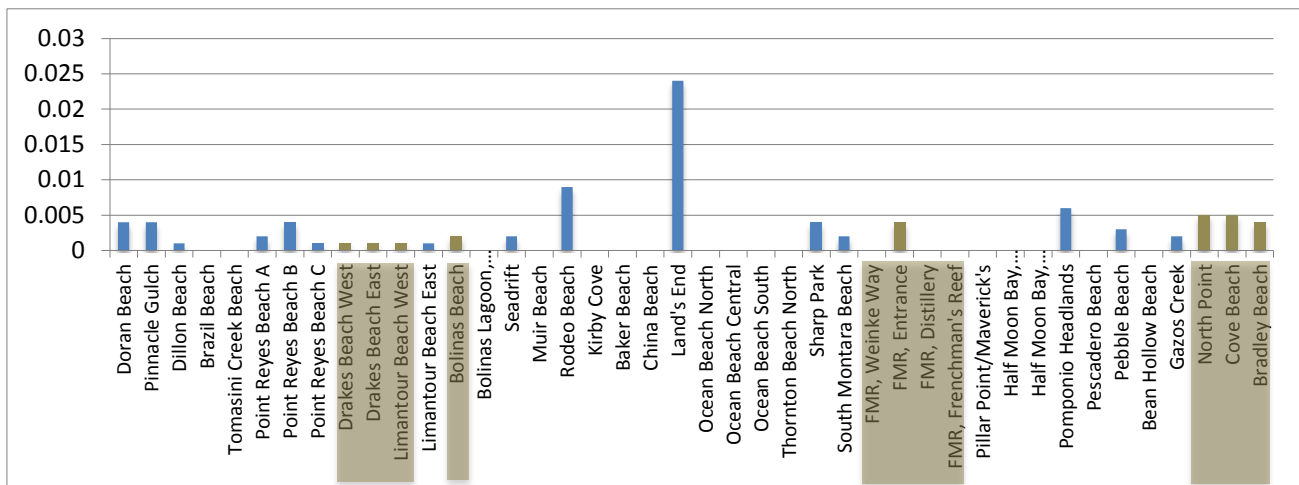
G4. Live California Sea Lion encounter rates (#/km), by beach, 1994-2012. Beaches within an MPA is shaded in brown.
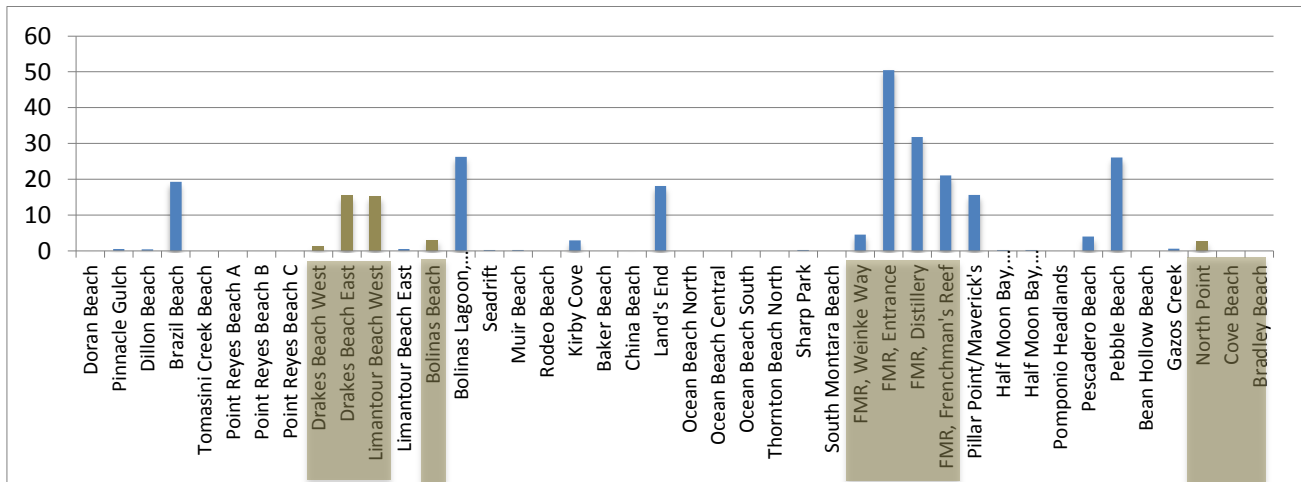
G5. Live Harbor Seal encounter rates (#/km), by beach, 1994-2012. Beaches within an MPA is shaded in brown.
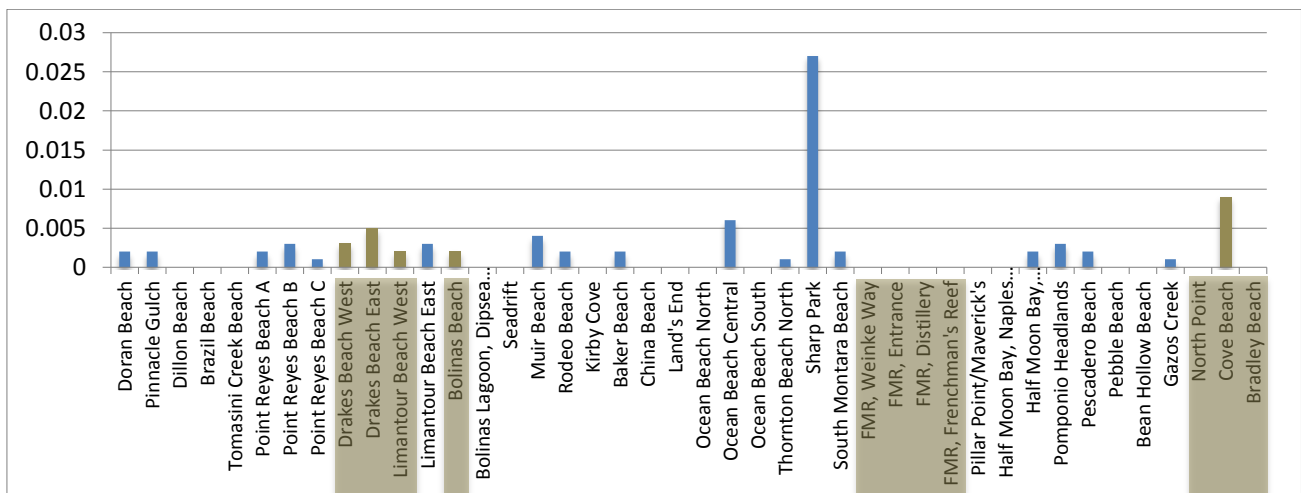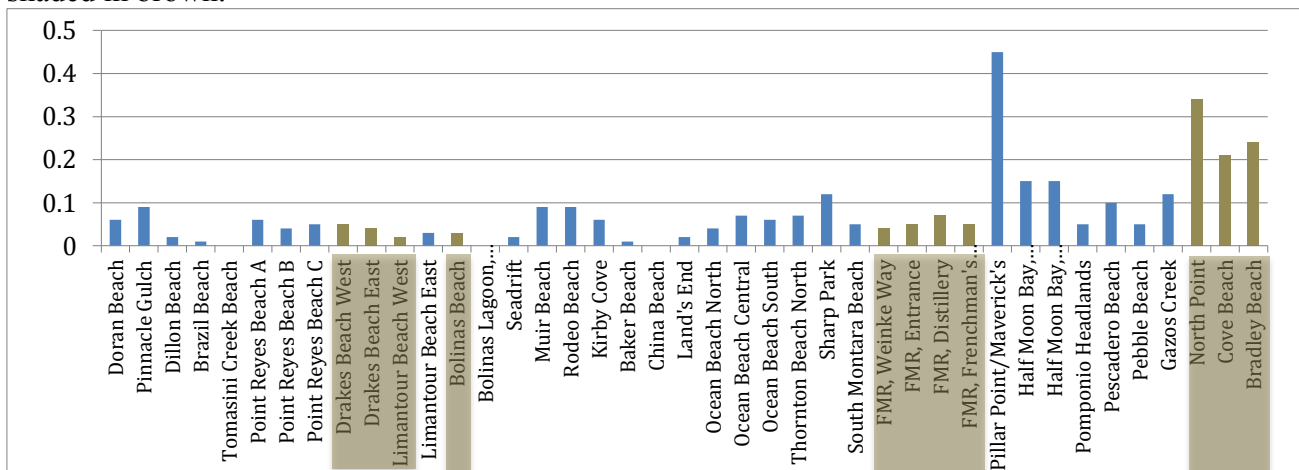

G6. Dead Harbor Porpoise encounter rates (#/km), by beach, 1994-2012. Beaches within an MPA is shaded in brown.
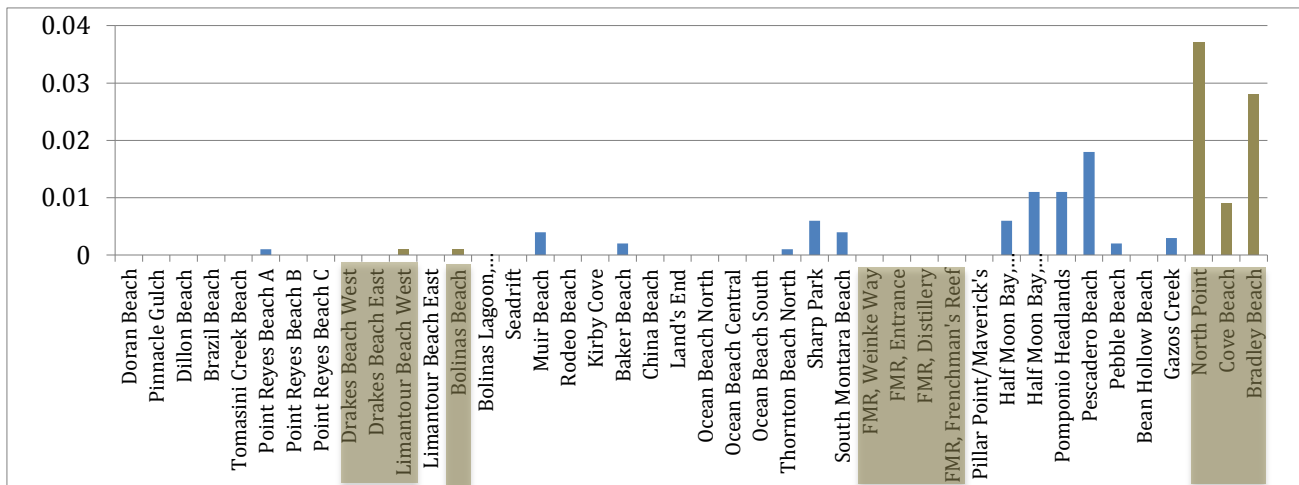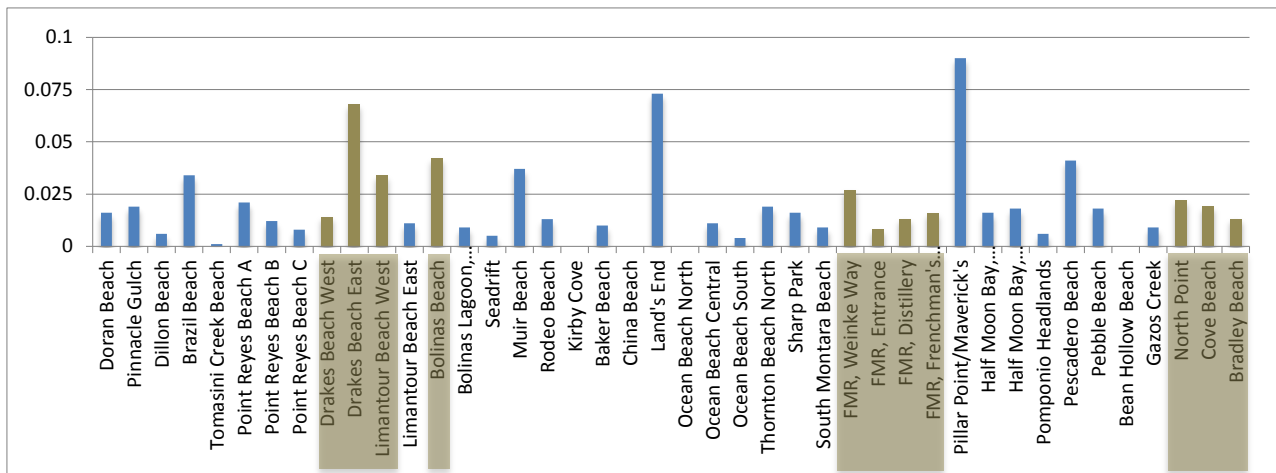
G7. Dead Sea Otter encounter rates (#/km), by beach, 1994-2012. Beaches within an MPA is shaded in brown.

G8. Dead Steller Sea Lion encounter rates (#/km), by beach, 1994-2012. Beaches within an MPA is shaded in brown.
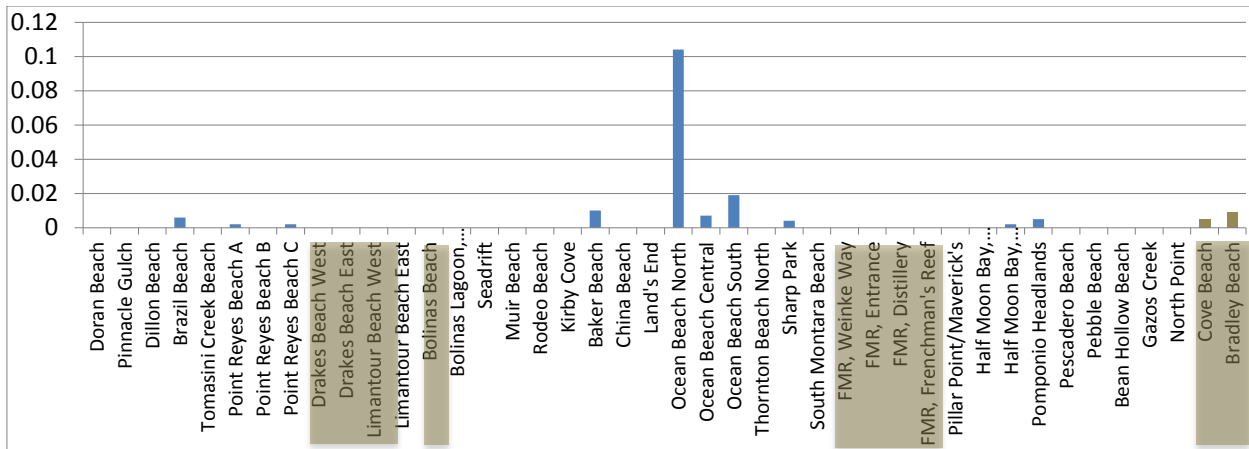

G9. Dead California Sea Lion encounter rates (#/km), by beach, 1994-2012. Beaches within an MPA is shaded in brown.
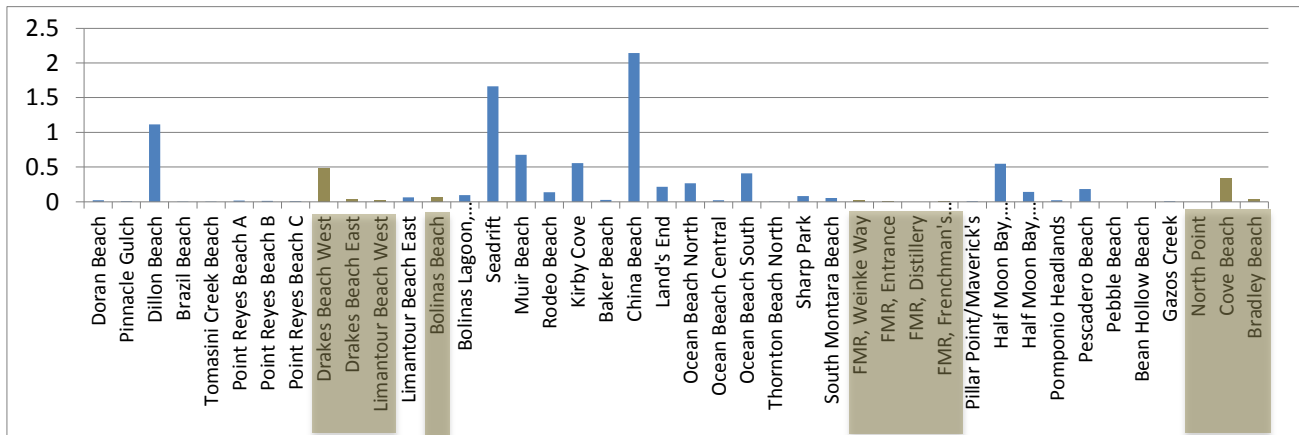
**G10.** Dead Harbor Seal encounter rates (#/km), by beach, 1994-2012. Beaches within an MPA is shaded in brown.

**Appendix H.** Human Uses Encounter Cumulative by Beach, 1994-2012

H1. ATVs cumulative encounter rate (#/km) by beach, 1994-2012, for each beach. Red bars indicate beaches within a NCC MPA.
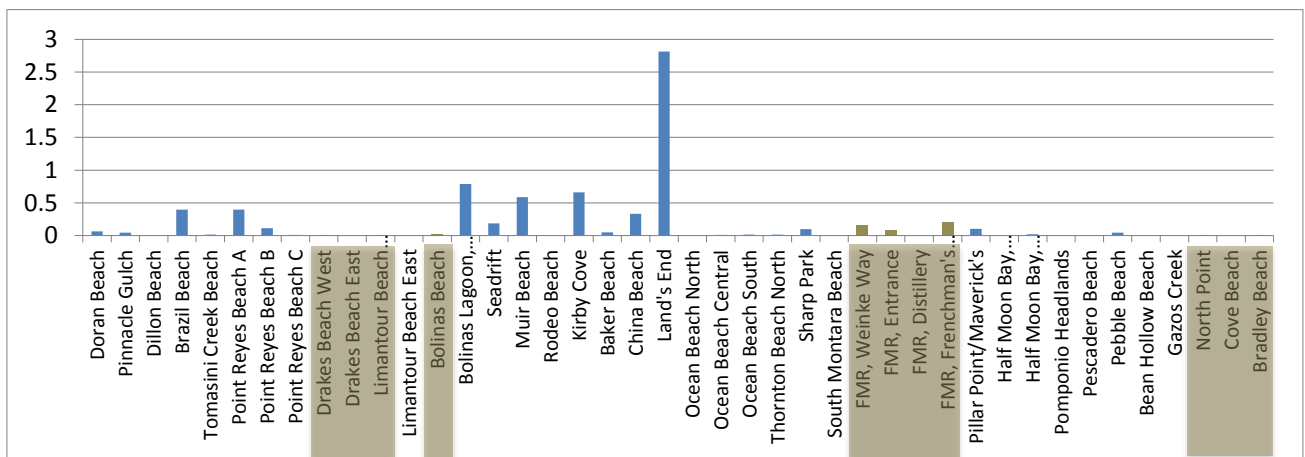

H2. Bathers cumulative encounter rate (#/km), 1994-2012, for each beach. Brown indicates beaches within MPAs.
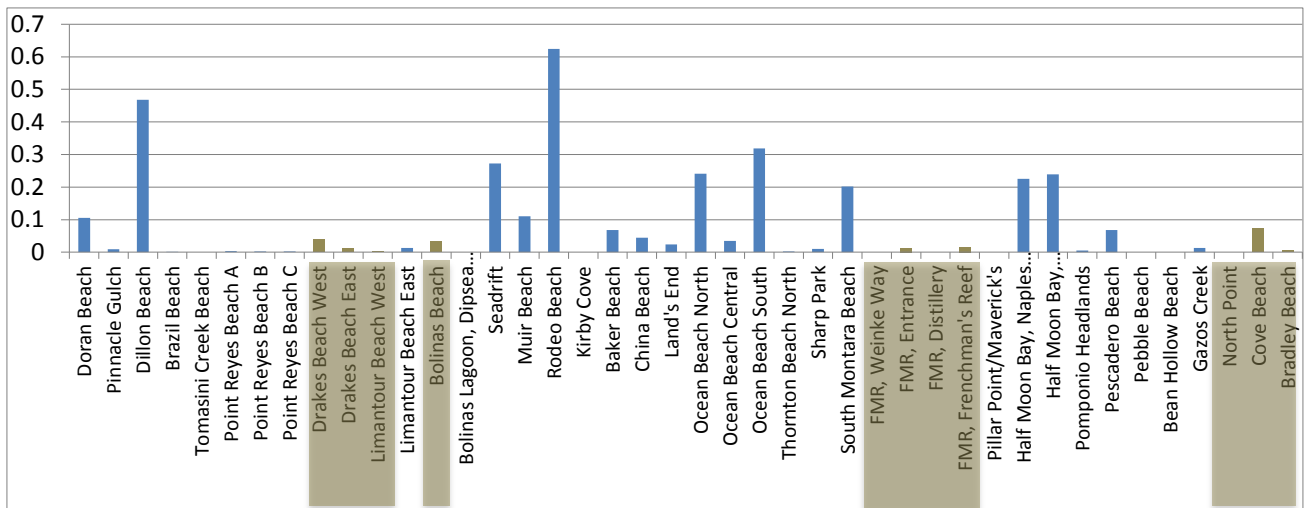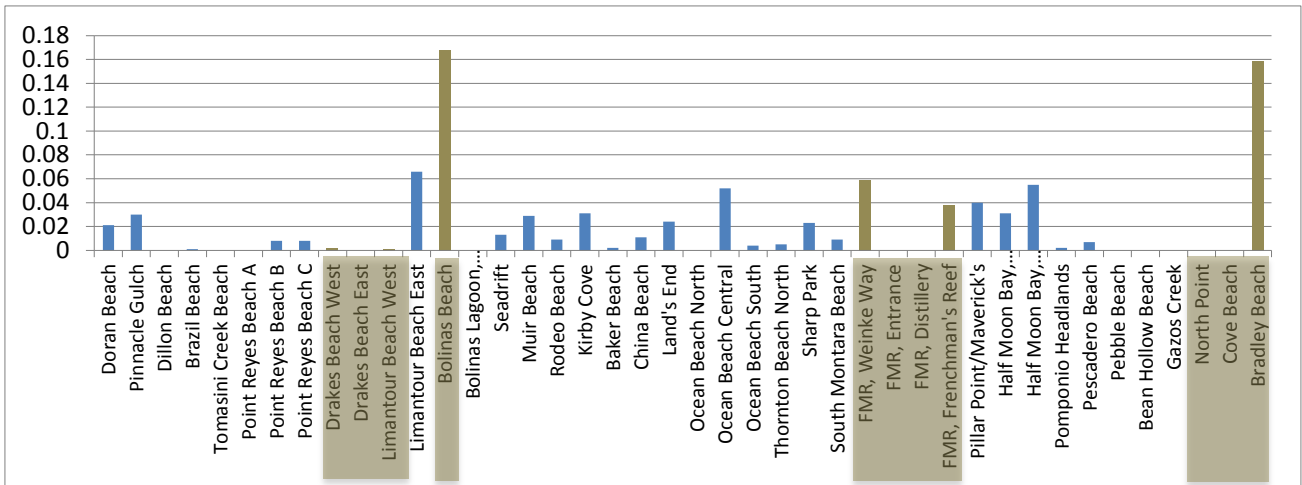
H3. Boogie Boarders cumulative encounter rate (#/km) by beach, 1994-2012. Brown indicates beaches within MPAs.
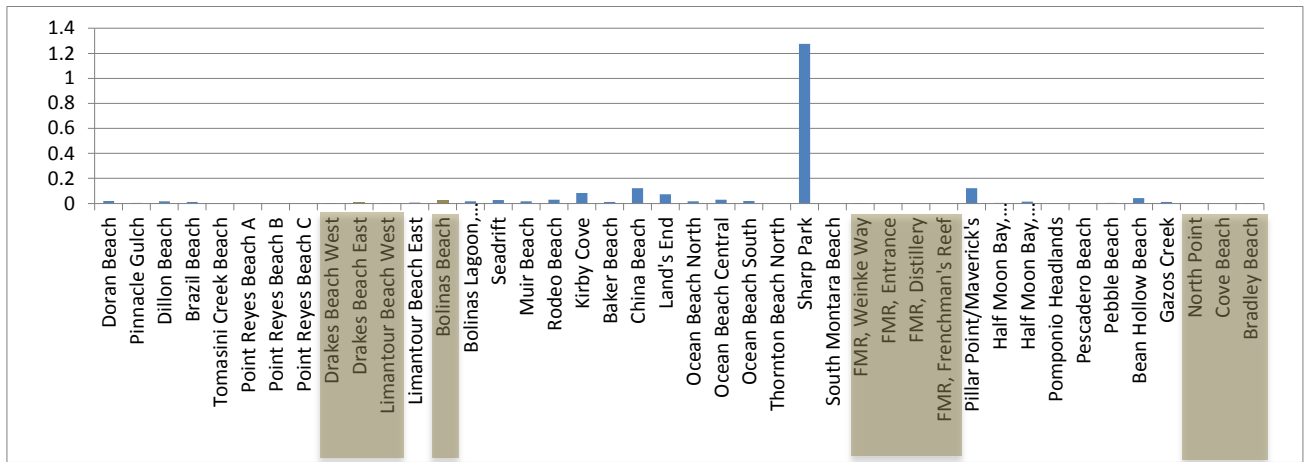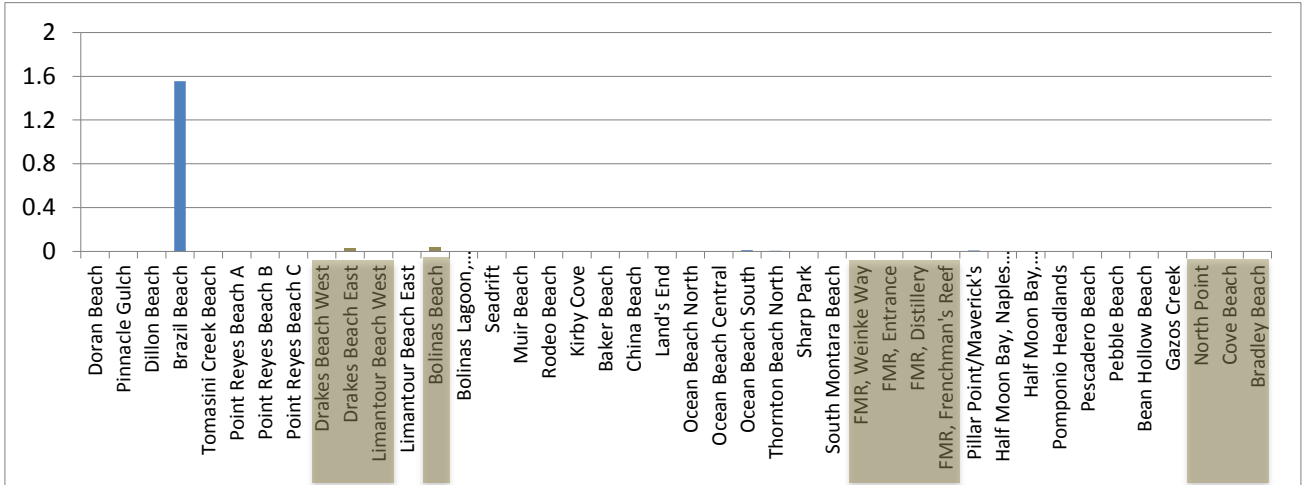

H4. Bikers cumulative encounter rate (#/km) by beach, 1994-2012. Brown indicates beaches within MPAs.

H5. Boaters cumulative encounter rate (#/km) by beach, 1994-2012. Brown indicates beaches within MPAs.

H6. Campers cumulative encounter rate (#/km) by beach, 1994-2012. Brown indicates beaches within MPAs.

H7. Clam Diggers cumulative encounter rate (#/km) by beach, 1994-2012. Brown indicates beaches within MPAs.

H8. Dog off Leash cumulative encounter rate (#/km) by beach, 1994-2012. Brown indicates beaches within MPAs.

H9. Dog on Leash cumulative encounter rate (#/km) by beach, 1994-2012. Brown indicates beaches within MPAs.

H10. Fishing cumulative encounter rate (#/km) by beach, 1994-2012. Brown indicates beaches within MPAs.
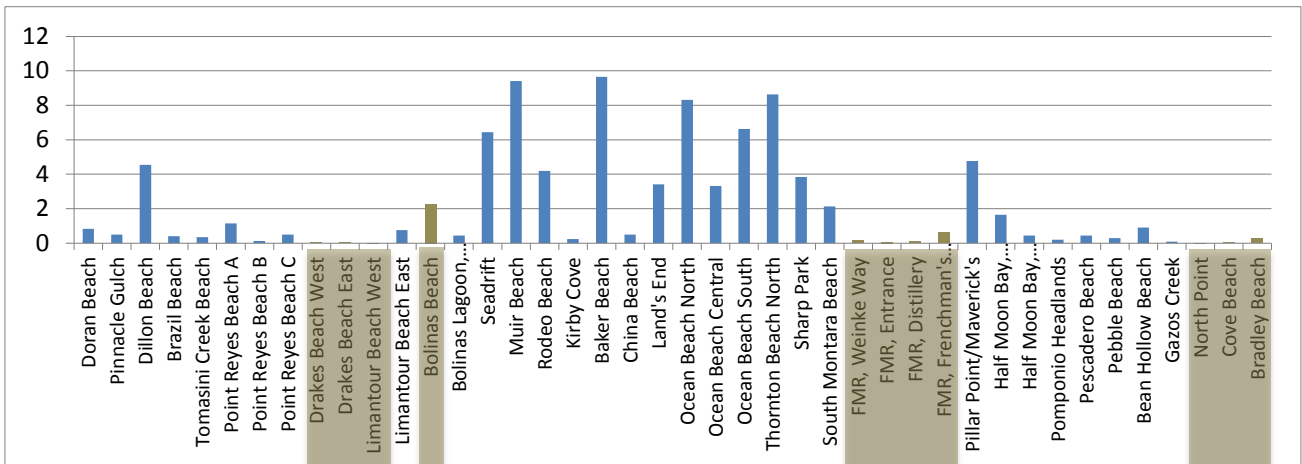

H11. Hang Gliders cumulative encounter rate (#/km) by beach, 1994-2012. Brown indicates beaches within MPAs.

H12. Horseback Riders cumulative encounter rate (#/km) by beach, 1994-2012. Brown indicates beaches within MPAs.

H13. Jet Skiers cumulative encounter rate (#/km) by beach, 1994-2012. Brown indicates beaches within MPAs.

H14. Kayakers, cumulative encounter rate (#/km) by beach, 1994-2012. Brown indicates beaches within MPAs.
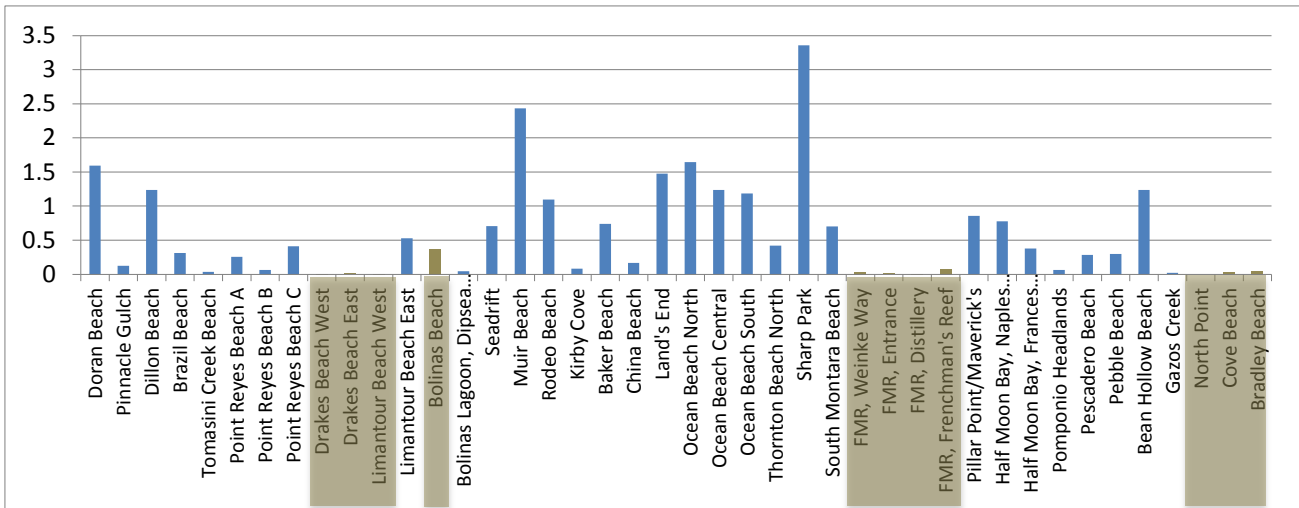
H15. Kite Fliers cumulative encounter rate (#/km) by beach, 1994-2012. Brown indicates beaches within MPAs.
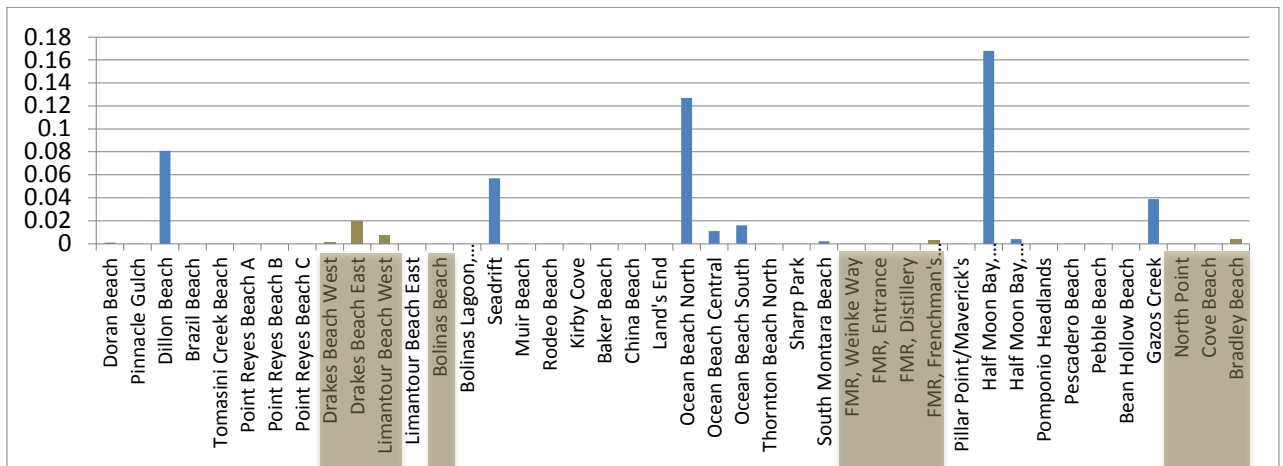
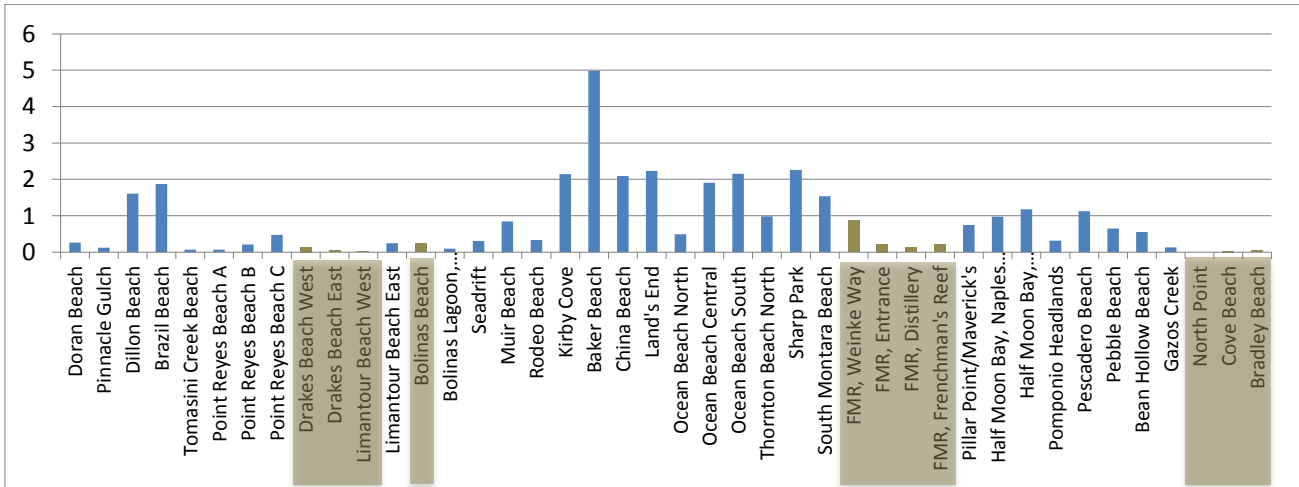**H16.** Kite Surfers cumulative encounter rate (#/km) by beach, 1994-2012. Brown indicates beaches within MPAs.
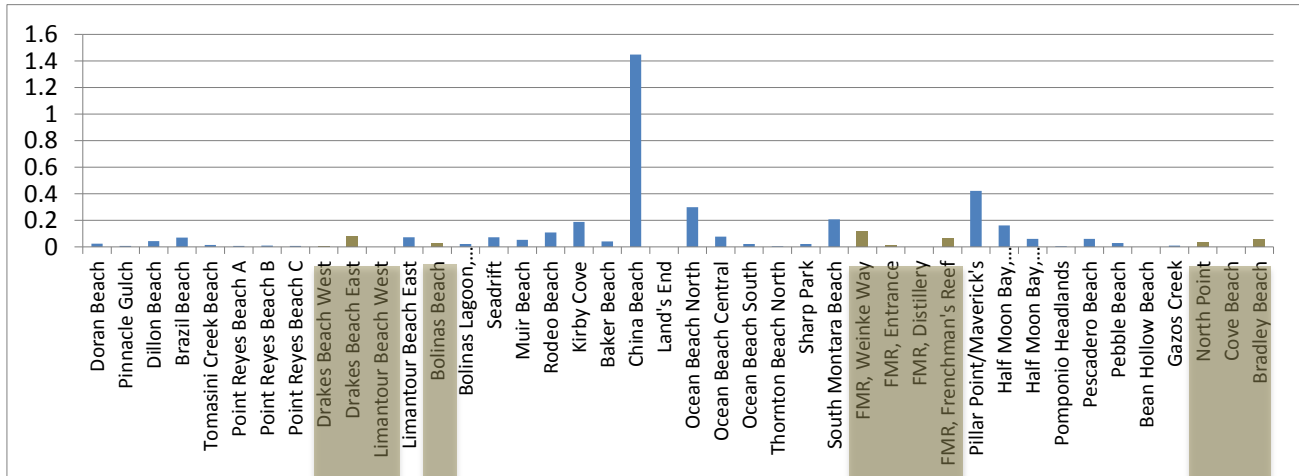
H17. Other Person, cumulative encounter rate (#/km) by beach, 1994-2012. Brown indicates beaches within MPAs.
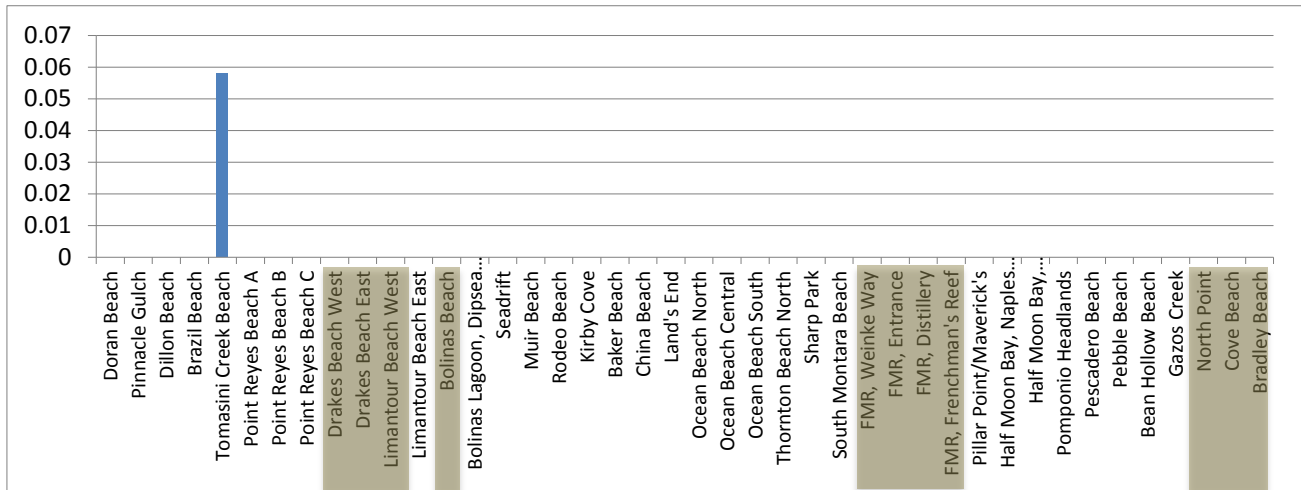
H18. Oyster Workers, cumulative encounter rate (#/km) by beach, 1994-2012. Brown indicates beaches within MPAs.
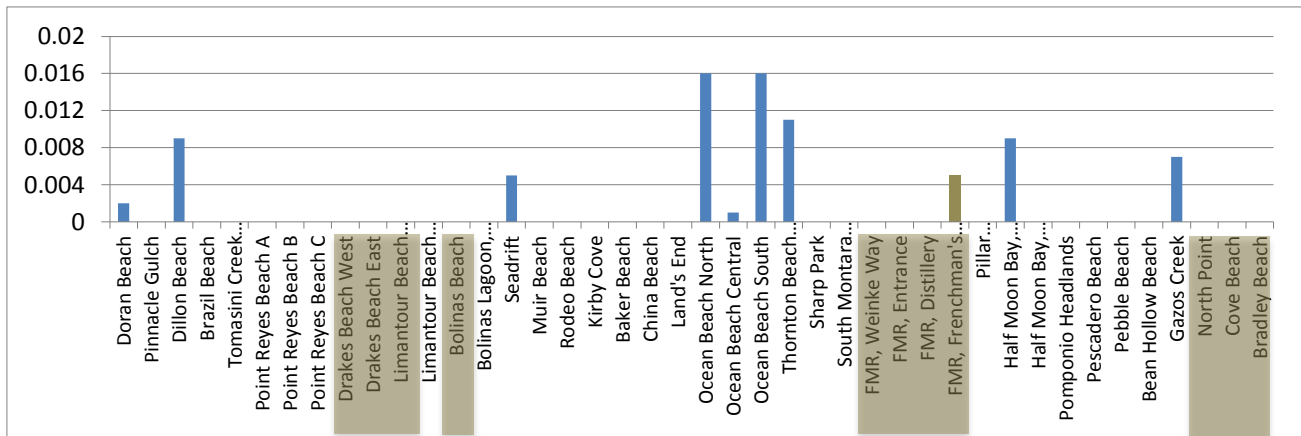
H19. Para Gliders cumulative encounter rate (#/km) by beach, 1994-2012. Brown indicates beaches within MPAs.
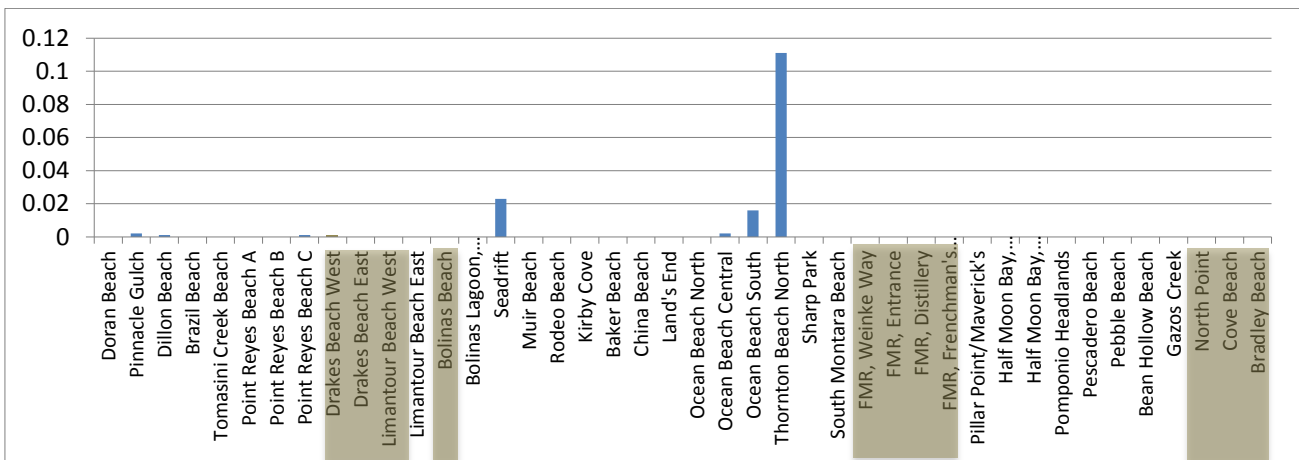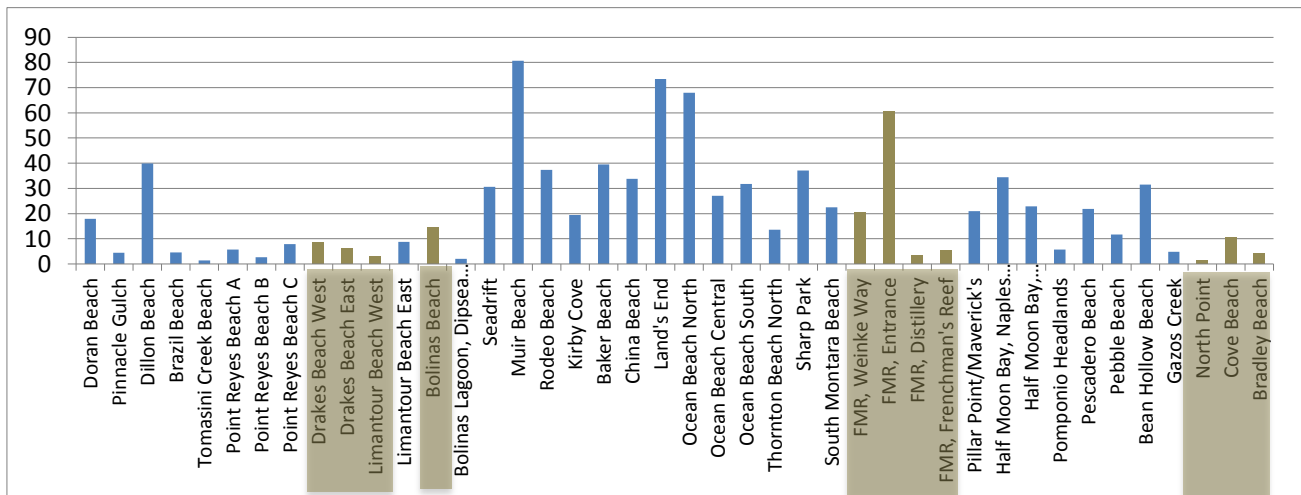

H20. Person on Beach cumulative encounter rate (#/km) by beach, 1994-2012. Brown indicates beaches within MPAs.

H21. Skim Boarders cumulative encounter rate (#/km) by beach, 1994-2012. Brown indicates beaches within MPAs.
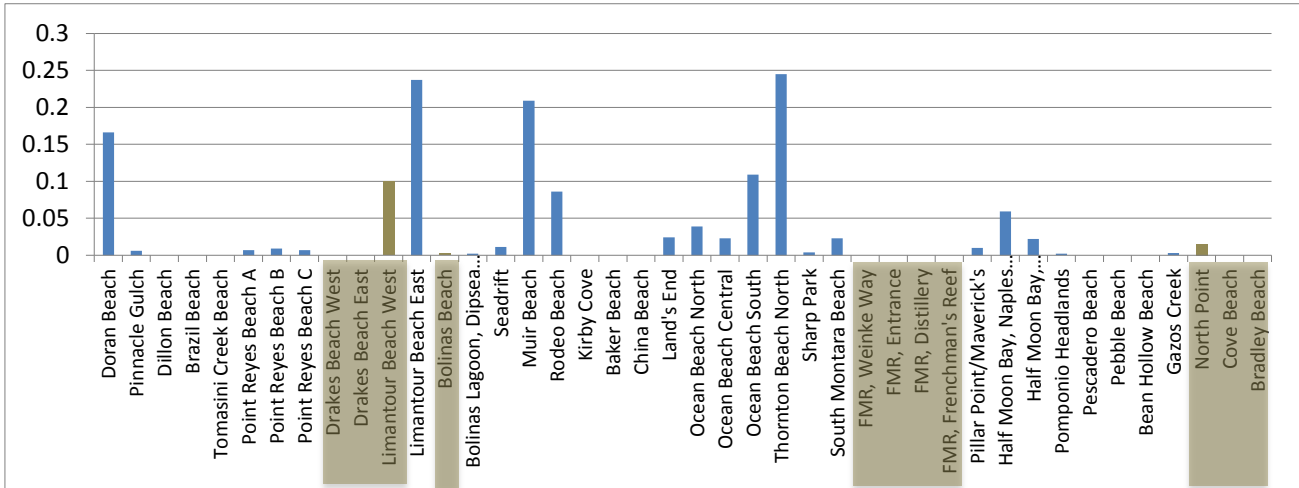

H22. Scuba Divers cumulative encounter rate (#/km) by beach, 1994-2012. Brown indicates beaches within MPAs.

H23. Surfers cumulative encounter rate (#/km) by beach, 1994-2012. Brown indicates beaches within MPAs.
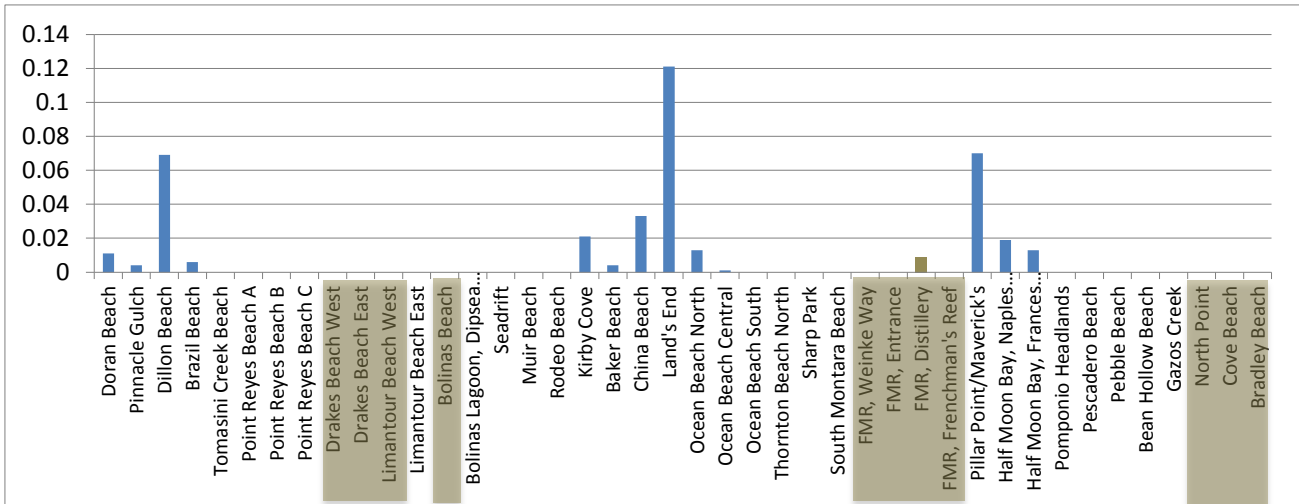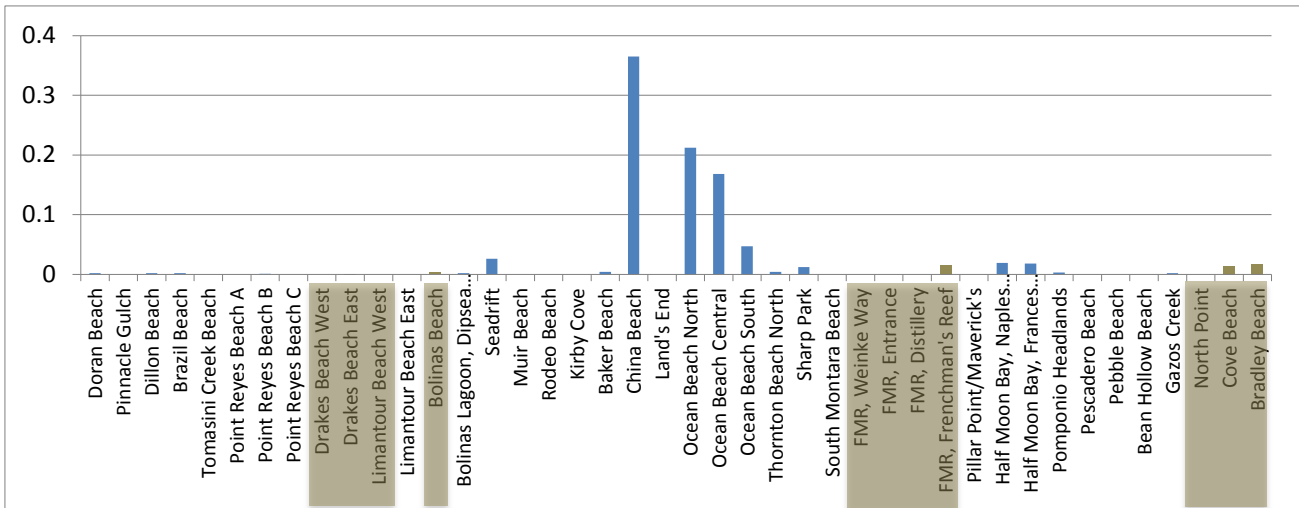
H24. Vehicles cumulative encounter rate (#/km) by beach, 1994-2012. Brown indicates beaches within MPAs.
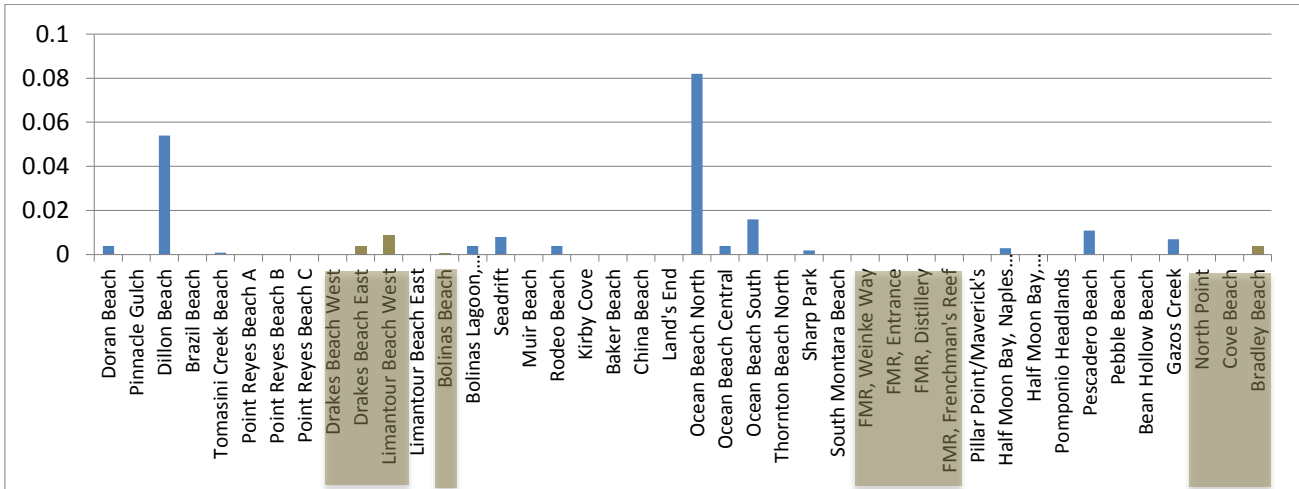
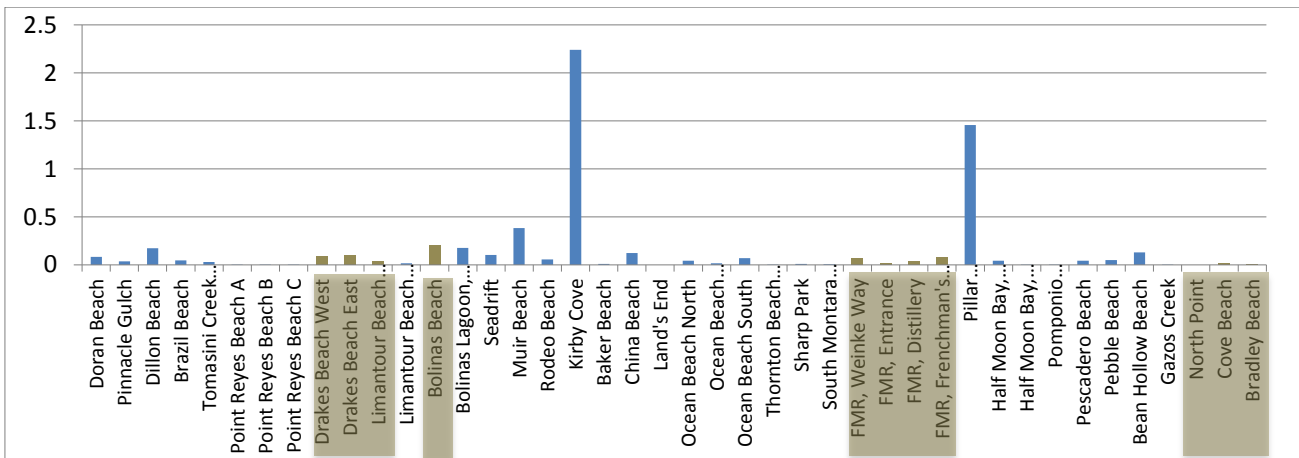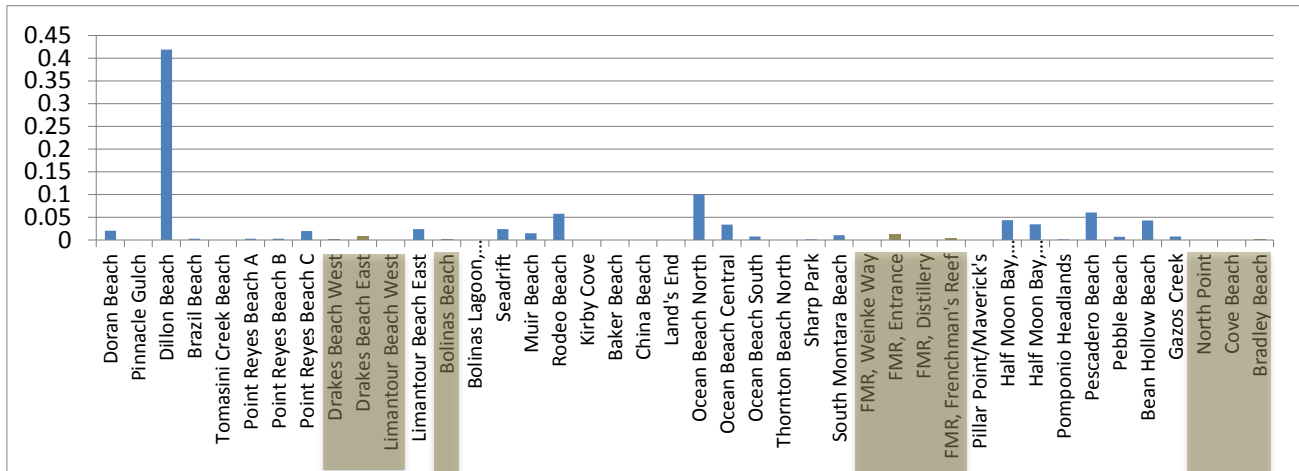**H25.** Wind Surfers cumulative encounter rate (#/km) by beach, 1994-2012. Brown indicates beaches within MPAs.
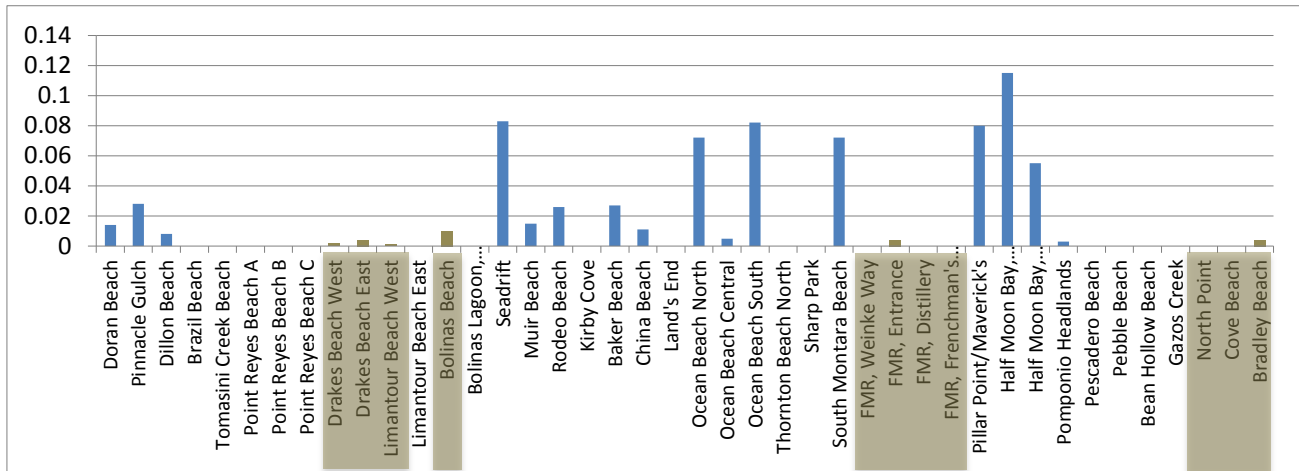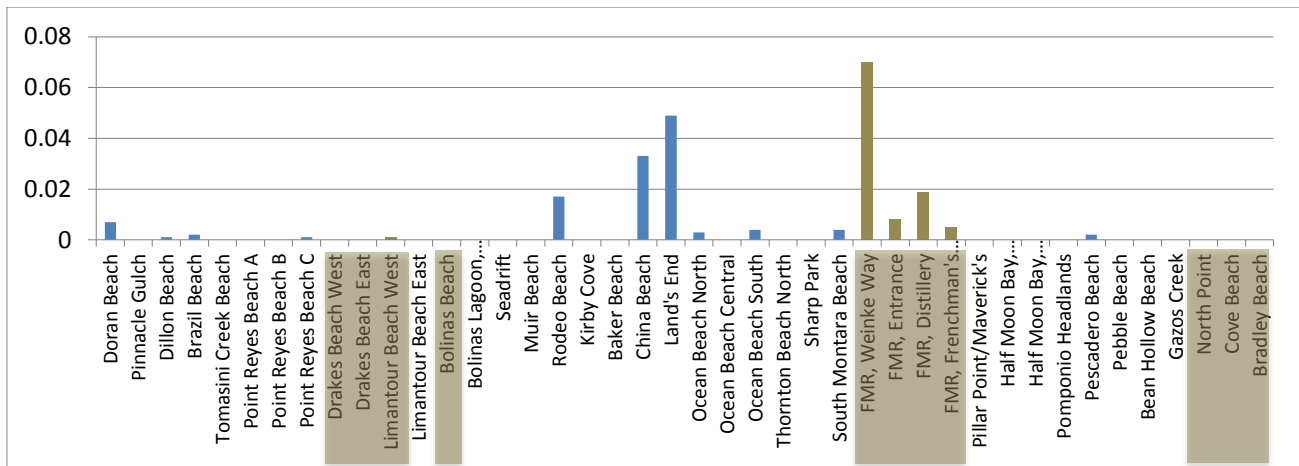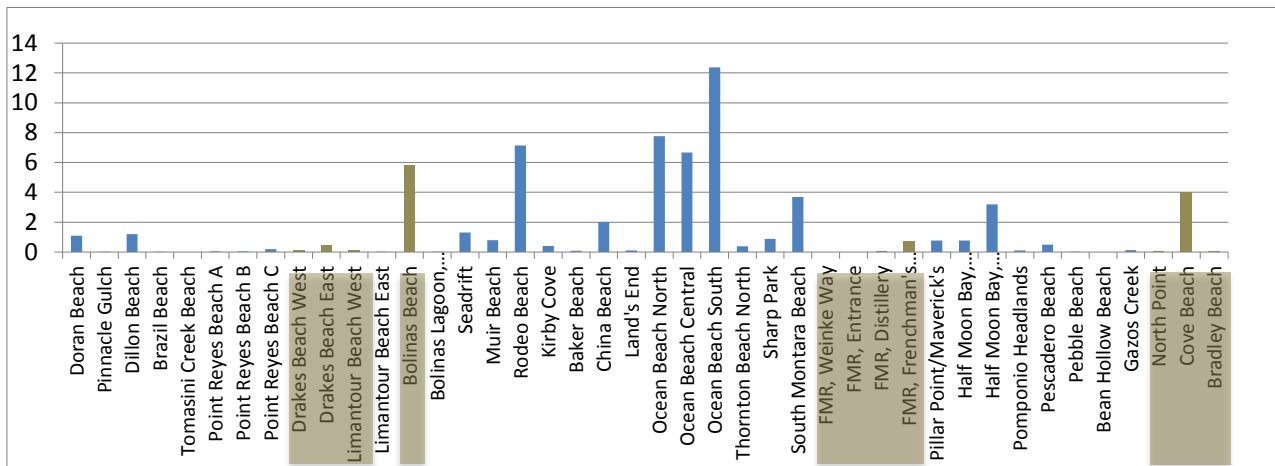
Appendix K. Beach Watch Data Sheets

Beach Monitoring Survey Time Begin_____ Time End_____ Page___of___ Date: m_____/d_____/y_____

Beach Number:	Beach Segment Name:	% Dead Surveyed:
Check Box if Cancelled:	Reason for Cancellation or Partial Survey:	% Live Surveyed:
Special Survey Name:	Scheduled Survey:	GPS photos:

Weather Beginning Tide Height: _____ Max. Beaufort Wind Scale: _____

Approx. Visibility (circle one) <300 ft. (.09 km) <1/4 mile (0.4 km) >1/4 mile (0.4 km)

Volunteer Information

Name of Surveyor	Prep Time (Hrs) A	Survey Time (Hrs) B	Roundtrip Drive Time (Hrs) C	Total Volunteer Time (Hrs) A+B+C	Roundtrip Mileage Per Car
			TOTALS		

Dead Vertebrates

Specimen No.	Species	Condition	Sex	Age	Photo	Oiled	Oiled Extent	Oiled Location	Scavenged	Probable Cause of Death	Tag #, Color & Location	Bill	Wing	Sternum	Tarsus	Comments on Back

Previously Documented Dead Vertebrates

Species								
# Found								

Invertebrate/Wrack Codes Enter data online: www.farallones.org

Mail data to: **FMSA, Attn. Beach Watch, 991 Marine Dr., San Francisco, 94129**

Species/Item	Abundance Code

For Staff Use Only | Tracker | Review | Transfer | Enter | Checked | Band Report |

Has Data Been Entered Online? Y N

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Live Species Count Form

	Date: M____ /D____ /Y____	Page ____ of ____

Beach Number: _____   Beach Segment Name: _____

Visitor Use (Count Yourself)

Activity Code	Total	Tally

Live Bird/ Mammal Count

Item #	Species Code	Total	# Oiled	Tally

Band / Tag Information (Live)

Species	Color		#		Other Types: Brand, Bleached, Radio Tag
	Left	Right	Left	Right	

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Photo Documentation Log   Page _____ of _____

Beach Number: _____   Beach Segment Name: _____

Surveyor(s): _____   Uploaded photos? [ ]

Date	Photo #	Speci-men #	Species Code	Sex	Age	Cause of Death	View	Comments

Staff Use Only   Birds [ ]   Mammals [ ]   Fish [ ]   Initials _____   Checked In [ ]   Download [ ]

Reminder: Your first photo is of date and beach number, and your last is your photo log.   Revised 8/1/2012