Three-Year Science Plan (2016-2018)
Marine Mammal & Turtle Division
Southwest Fisheries Science Center, NOAA Fisheries

http://swfsc.noaa.gov/mmtd.aspx

Major Field Efforts (through 2018, *some 2019*)

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Annual

Gray Whale Calf Production and Condition *(pending funding)*
March-May; Piedras Blancas Lighthouse Station, CA

Coastal Bottlenose Dolphin Ecology (*suspended 2014 due to lack of funding and infrastructure*)
Year-round; Southern California Bight

California Current Humpback and Blue Whale Photographic Identification (*suspended 2010 due to lack of funding)*
June-November; coastal California, Oregon, and Washington waters

Bahamas Behavioral Response of Deep-Diving Cetaceans to Navy Sonar (*pending funding)*
Spring & Fall; Bahamas

Northern and Southern Resident Killer Whale Condition Assessment (*pending finding*)
Summer & Fall; Pacific Northwest coast

Antarctic Killer Whale Biology, Ecology, and Ecosystem Impacts *(pending funding)*
December-March; Southern Ocean

California Sea Lion Diet
Quarterly; San Nicolas and San Clemente islands

California Sea Lion Abundance Survey
July; southern CA

Green Turtle Biology
Year-round; San Diego Bay, San Gabriel River, Seal Beach National Wildlife Refuge

St. Croix Leatherback Turtle Life History *(pending funding)*
March-August; St. Croix, US Virgin Islands

Pacific Leatherback Turtle Life History (*pending funding*)

Papua-Indonesia, Mexico, Costa Rica

Eastern Pacific Hawksbill Turtle Life History (*suspended 2015 due to lack of funds*)
El Salvador, Nicaragua & Panama

Calendar Year 2016

Southern California Behavioral Response Study
July-September; Southern California Bight

Gray Whale Abundance Survey *(pending funding)*
January-February; Granite Canyon, CA
Repeated 2 back-to-back years every 3-4 years

California Northern Elephant Seal Survey
Winter; Coastal California
Repeated at 3 year intervals (last survey 2013)

Steller sea lion survey (*pending funding*)
Summer; U.S. West Coast

Central California Leatherback Turtle Abundance and Distribution Survey *(pending funding)*
September-October

Calendar Year 2017

Central California Leatherback Turtle Abundance and Distribution Survey *(pending funding)*
September-October

California Harbor Seal Survey *(pending funding)*
May-July; Coastal California
Repeated at 3 year intervals (last estimate 2014)

Calendar Year 2018

California Current Cetacean & Ecosystem Assessment Survey (*pending ship time and funding*)
August-November; California Current
Repeated at 3-4-year intervals (last survey 2014)

Calendar Year 2019

California Harbor Porpoise Survey *(pending funding)*
August-November; coastal California
Repeated at 4 year intervals (last estimate 2015)

Additional NOAA Research Vessel Surveys (pending ship time and funding)

Large Whale Survey: North Pacific Fin Whale Abundance and Stock Structure
August-November (120 sea days); greater north Pacific

Beaked whale abundance survey
August-November (120 sea days); California Current

Loggerhead Turtle Process Cruise
Late summer/fall (~30 sea days); southern California waters

Oregon and Washington Leatherback Turtle Abundance and Distribution Survey
September-October; coastal Oregon and Washington

Eastern Tropical Pacific Cetacean & Ecosystem Assessment Survey
August-November (240 sea days, 2 ships); eastern tropical Pacific

Major Scientific Contributions and Products

Population Abundance Assessment and Trends

Mammals

- Annual revision to Marine Mammal Stock Assessment Reports (Carretta, Forney, Barlow, Moore & other Centers)
- Annual estimates of marine mammal bycatch for west-coast gillnet fisheries, including model-based inference in rare-event situations (Carretta, Moore & West Coast Regional Office)
- Cetacean abundance trends in the CA Current (Moore and Barlow)
- Bayesian trends power analysis; recommended study design to estimate beaked whale trends in Southern CA Bight (Moore, Curtis, Barlow et al.)
- Beaked whale habitat model in the Southern California Bight using sightings and multiple acoustic datasets (Baumann-Pickering, Moore, Yack, et al.)
- Development of acoustic survey, monitoring, and mitigation methods for marine mammals (Rankin, Yack, Barlow, Forney, Jacobson)
- Harbor porpoise abundance and trend estimates from visual and CPOD acoustic data - Pacific stocks (Forney, Jacobson et al.)
- Update CA Current abundance estimates - post-2014 CALCURCEAS (Barlow/Forney et al.)
- Estimation of trackline detection probability (g(0)) for visual and acoustic line-transect surveys of cetaceans (Barlow et al.)
- Bottlenose dolphin carcass recovery estimation (Carretta)
- Vaquita abundance trends from acoustic monitoring data (multi-institutional collaboration incl MMTD)
- Assessment model for spotted and spinner dolphins integrating sightings, habitat, and life history data (Gerrodette et al. incl IATTC)

- Estimates of abundance and trends for all ETP cetaceans using Bayesian space-state models (Gerrodette, Eguchi, et al.)
- The accuracy of dolphin school size estimation (Gerrodette & Perryman)
- Development of line-transect and mark-recapture models with spatial autocorrelation (Multi-institutional collaboration: Gerrodette, Borchers, Ilian, Lindgren)
- Abundance of bottlenose dolphins in coastal waters of southern California using photographic identification and mark-recapture analysis (Weller et al.)
- Abundance of eastern north Pacific gray whales based on new shore-based count methods and night vision data (Durban et al.)
- Abundance of beaked whales on and away from a Navy sonar range in the Bahamas (Durban et al)
- Abundance of mammal-eating killer whales in coastal waters of the NE Pacific using photographic mark-recapture methods (Durban)
- Abundance and health assessment of Chilean blue whales in coastal waters of Chile using photographic mark-recapture methods (Brownell)
- Development of Bayesian mark-recapture models for investigating local dynamics within open populations (Durban et al.)
- Development of Bayesian spatially-explicit mark-recapture approaches for examining spatial population structuring alongside estimates of abundance and demographic trends (Durban et al.)
- Meta-analysis of photographic mark-recapture assessments for cetaceans, with application to bottlenose dolphins (Durban et al.)
- Proof of concept and study design for development of population matrix models that explicitly include sociality and behavior (Mesnick, Moore et al.)
- Behavioral response of ETP dolphins relative to purse-seine effort in the context of stock population trends (Mesnick, Archer et al.)

Turtles

- ESA green turtle status review (Seminoff, Eguchi, Dutton, Allen, Jensen)
- IUCN Red List green turtle assessment (Allen and Seminoff)
- Loggerhead turtle density and abundance along Pacific Baja California (Eguchi, Seminoff, Benson)
- Pacific Leatherback Turtle Assessment Working Group (Joint report by SWFSC, PIFSC, SWRO, PIRO)
- ESA green turtle critical habitat determination (HQ, and Science Centers)
- ESA olive ridley status review team (to begin late 2016)
- ESA leatherback turtle assessment (Dutton et al.)
- Pacific Green Turtle Genetics Working Group
- Sea Turtle bycatch stock ID assessment (Stewart & Dutton)
- Genetic tools to census Hawaiian green and Texas Kemp's Ridley turtles (Frey and Dutton)
- Leatherback population/demographic model (Dutton, Stewart, Eguchi et al.)
- Leatherback mortality reference point estimation (Curtis, Moore, Benson)

- Improving capacity of stock assignment for sea turtles: using ocean circulation modeling to inform genetic mixed stock analysis (Jensen, Kobayashi, Dutton)

Population Structure

Mammals

- Complete publication of framework to define marine mammal species and subspecies globally (Taylor and Perrin et al.)
- Genetics R package (Archer)
- mtDNA & msat quality control R code (Archer/Martien)
- Continued accrual of samples and loans from collection (Serra-Valente/Robertson *pending funding*)
- Defining units to conserve:
    - Endangered Species Act
        - Sperm whale global phylogeography (Morin et al.)
        - Fin whale taxonomy (Archer et al.)
        - Blue whale taxonomy (Lang et al.)
        - Killer whale taxonomy, 3 projects (Morin et al.)
        - False killer whale taxonomy (Martien et al.)
        - Hawaiian false killer whale, social structure and Ne (Martien et al.)
        - Ice seals (Lang, collaboration with NMML, *pending funding*)
        - Western gray whale population structure (Lang et al.)
        - Melon-headed whale phylgeography and population structure (Martien et al.)
    - Marine Mammal Protection Act
        - Workshop defining stock structure with few or no genetic data (GAMMS III recommendation, Martien et al.)
        - Fin whale population structure within the North Pacific (Archer et al.)
        - Pacific Coast Feeding Group gray whale population structure (Lang et al., *pending funding*)
        - Western gray whale relatedness and population structure (Lang)
        - Bottlenose dolphin stock structure: Channel Islands (Lang et al.)
        - Bottlenose and Frasier's dolphin stock structure: Marianas and Hawaiian Islands (Martien et al.)
        - Beaked whale stock structure in the Bahamas (Morin et al.)
        - Melon-headed whale stock structure in the Pacific Islands region (Martien et al.)
        - Pygmy killer whales in Hawaii (Martien et al.)
        - Pilot whales in Hawaii and Marianas (VanCise et al.)
        - Harbor porpoise, CA/OR/WA update (Morin *pending funding*)
        - ETP spinner and spotted dolphin population structure (Leslie et al.)

Turtles

- Global foraging group structure of leatherback turtles determined via isoscape analysis (Seminoff et al.)
- Foraging structure of western Atlantic leatherback turtles determined via stable isotope analysis (w/ Canada DNR; Wallace, James, Seminoff)
- Stock origin of green turtles foraging off of southern California, USA, using mtDNA (LeRoux et al.)
- Sea turtle strandings along the U.S. West Coast; species distribution and nesting beach origins (LeRoux et al.)
- Publish, update and assemble working database on stock structure for green, leatherback, loggerhead, and hawksbill turtles to identify units to conserve globally (DPS, MU's) and create capacity to conduct stock assessments, address ESA mandates, Recovery Plan objectives, and respond to management issues (stock ID of fisheries bycatch, Section 7 consultations); (w/ PIRO, SWR, PIFSC, SEFSC)
    - Pacific green turtles (Jensen et al.)
    - Atlantic and Indian Ocean green turtles (Jensen, Dutton et al.)
    - Pacific loggerhead turtles (Dutton, LeRoux et al.)
    - Atlantic and Pacific loggerhead turtles
        - Working database of new sequence data (Dutton et al.)
        - Rookery management units (Fitzsimmons, Dutton, Shamblin et al.)
    - Pacific leatherback turtles (Dutton et al.) stock structure analysis
    - Atlantic leatherback turtle stock structure (Dutton et al.)
    - Eastern Pacific hawksbill turtle stock structure (Gaos et al.)
    - Pacific Islands hawksbill stock structure (Dutton, Gaos et al.)
    - mtDNA sequence baseline datasets and haplotype nomenclature tool on SWFSC website
- Develop SNPs, whole mitgenome sequencing and genomics for all 7 species of marine turtles (Dutton, Morin et al.)
    - Hawksbill turtle SNP genotyping analysis (Frey, Dutton, Gaos et al.)
    - Green turtle SNP genotyping analysis (Roden et al.)
    - Leatherback turtle SNP genotyping analysis (Komoroske, Roden, Dutton)
    - Loggerhead turtle SNP discovery & genotyping analysis (Frey et al.)

Life History, Health, Condition

Mammals

- Multiple age-at-death datasets to estimate life history parameters and impacts of bycatch for three odontocetes (Moore)
- Length and width measurements of gray whales from vertical aerial photographs and relationships with climate/weather in the Arctic (Perryman et al.)
- Comparison of reproductive parameters based on hormone levels in biopsy samples versus other data sources for common dolphins (Kellar et al.)
- Common dolphin demography, reproduction, and niche partitioning through combined study of reproductive hormones, environmental data and data extracted from vertical aerial photographs (Chivers et al.)

- Contaminant loads
    - coastal bottlenose dolphins in the southern California Bight (Weller et al.)
    - short-beaked common dolphins in the Southern California Bight (Chivers et al.)
- Gas bubble analyses lead to identification of Clostridium sp. infection (Danil et al.)
- Trends in causes of death among San Diego County cetacean strandings (Danil et al.)
- Life history parameters of Mekong River dolphins based on data from specimens taken as bycatch and photo-id studies (Brownell et al.)
- ETP spotted and spinner dolphin reproduction relative to purse-seine fishing effort (Kellar et al.)
- Morphology and life history parameters (timing of reproduction, length of cow/calf association) for 3 forms of spinner dolphins in the ETP based on data from specimens and aerial photographs (Chivers et al.)
- Fetal mortality of spotted and spinner dolphins in the ETP and relationship to tuna purse seine fishing effort (Chivers et al.)
- Behavioral responses of beaked whales and other odontocetes to Navy sonar exposure at the US Navy's Atlantic Test and Evaluation Center in the Bahamas (Durban et al.)
- Deriving quantitative measures of killer whale body condition from aerial photogrammetry data (Durban et al.)
- Changes in body condition of Southern Resident killer whales relative to prey availability (Durban et al.)
- Reproduction in female Southern Resident killer whales based on dead specimens and the long-term photo-id dataset (Brownell et al)

Turtles

- Home range of green turtles in San Diego Bay determined via GPS-tracking (Eguchi et al.)
- Foraging structure of western Atlantic leatherback turtles determined via stable isotope analysis (w/ Canada DNR; Wallace, James, Seminoff)
- Oceanic life-stage elucidation for loggerhead turtles through skeletochronology and stable isotope analysis (with Nat'l Sea Turtle Aging Lab; Seminoff and Avens)
- Biology and Conservation of Sea Turtles of West Africa (Tiwari and Fretey, editors)
- Hatchling sex ratio and pivotal temperature of eastern Pacific hawksbill turtles (Eguchi et al.)
- Internesting activity and dive behavior of leatherback turtles in Jamursba Medi, Papua (Okuyama et al.)
- Foraging activity and dive patterns of Pacific leatherback turtles during transPacific reproductive migrations (Benson et al.)
- Dive behavior and movements of leatherback turtles within the US EEZ (Eguchi et al.)

- Validation of a testosterone elisa for sex determination and reproductive assessment of six sea turtle species (Allen et al.)
- Sex ratios of six sea turtle species among multiple foraging areas worldwide (Allen et al.)
- Habitat use of north pacific loggerhead turtles (*Caretta caretta*) and duration spent in a high-bycatch area near Baja California Peninsula using skeletochronology and stable isotope analysis (Seminoff, Turner Tomaszewicz)
- Novel genetic tools/approaches to determine marine turtle population vital rates: age maturity, survivorship, sex ratios (Stewart and Dutton)
- Pacific green and leatherback stock-specific habitat linkage model using genetics genotyping and sequence datasets (Jensen, Roden, Dutton et al.)
- Atlantic leatherback stock-specific risk assessment; overlaying fishing, habitat and stock distribution distribution maps (Stewart & Dutton)
- Functional genomics of sea turtles (Komoroske)
- Loggerhead movements and habitat use in southern California Bight determined via satellite telemetry (Eguchi, Seminoff)

Marine Mammals and Turtles in an Ecosystem Context

Mammals

- Pinniped food consumption from scat analyses (Lowry)
- Acoustic-based models of cetacean distribution/density in central Pacific (Barlow et al., with PIFSC)
- Pacific cetacean density models based on species-habitat relationships (Becker, Forney, Barlow et al.)
- Relationship between the extent of seasonal ice in the Arctic and calf production in the eastern North Pacific population of gray whales (Perryman et al.)
- Niche separation of deep-diving odontocetes in the Bahamas; from telemetry data on movements, habitat use and diving behavior (Durban et al.)
- Space use and ship strike risk of migrating gray whales in the Southern California Bight (Durban et al.)
- Ecotypic variability within killer whales of the Antarctic Peninsula; from morphometrics, telemetry, diet and genetic data (Durban, Pitman et al.)
- Abundance estimates and trophic impact of killer whales within a diverse ecotypic assemblage around the Antarctic Peninsula (Durban, Pitman et al.)
- Impact of predation by killer whales on marine mammals in the North Pacific (Durban et al.)
- A framework for identifying priority habitat for large whales in the eastern Pacific (Redfern et al.)
- Trends in cetacean abundance using species-habitat relationships (Redfern et al.)
- Transferability of habitat models built in data-rich regions to data-poor regions (Redfern et al.)
- Noise risk assessment for Southern California waters (Redfern et al.)

- Spatial and temporal characteristics of ETP dolphin sets from tuna vessel observer data to assess the potential for separation of dolphin mothers and calves (Edwards et al.)
- Risk of large whale ship strikes off San Francisco, and the US west coast (Redfern et al.)
- Framework and methods for identifying critical habitat for highly-mobile species (Boyd and Redfern).
- Development of an individual-based model of Southern Resident killer whales to support identification of critical habitat throughout their range (Boyd et al)
- Comparison of MaxEnt and GAM to explore whether presence-only data improve the prediction or explanation of species distributions (Fiedler et al.)
- Analysis of tuna vessel observer effort and sightings data to assess how ETP dolphin distributions change in response to seasonal and interannual environmental variability (Fiedler)
- Causes of warming events in the California Current (Fiedler et al.)
- Ensemble averaging and nesting of cetacean habitat models to improve reliability of predictions (Redfern, Fiedler et al.)
- Compliance with requests to change ship speed and travel patterns in San Francisco Bay and the Monterey Bay National Marine Sanctuary using AIS data (T. J. Moore et al.)
- Primary shipping routes and temporal changes in shipping traffic patterns (T. J. Moore)
- Current and historic global fin whale distributions and potential breeding areas (Edwards et al.)
- Cetacean species richness hotspots in the eastern tropical Pacific and implications for oceanic conservation (Ballance, Redfern, Fiedler, and Pitman)
- Ecosystem services provided by the eastern tropical Pacific (Martin and Ballance)

Turtles

- Foraging energetics of leatherback turtles along the central California coast (Benson et al.)
- A 'TurtleWatch' product for leatherback turtles in the North Pacific using a suite of oceanographic indicators (Benson, Howell, Eguchi, Seminoff, Dutton)

Additional

- Bycatch and Indirect Fisheries Impact Research: estimating bycatch, determining indirect fishery effects, determining sustainable bycatch levels for long-lived vertebrates, PBR-like framework for marine turtles, determining pinger efficacy, assessing international bycatch (Moore, Carretta, Curtis et al.)
- Spotted Dolphin Book (Perrin and Gerrodette, eds.)
- Sea Turtle Forensics: Determining spatial origins of hawksbill 'bekko' shell contraband confiscated by U.S. Customs (Van Houtan and Seminoff)
- Distribution and trends of sea turtle strandings along the U.S. West Coast (LeRoux et al.)

- Biodiversity conservation through mitigation, policy, economic instruments, and technical change (Dutton and Squires)
- Best practices for sea turtle nesting beach conservation (Tiwari, Dutton, Squires et al.)
- Atlas of seabird distribution in the eastern tropical Pacific from 1986-2006 (Pitman and Ballance et al.)
- Habitat use of endangered seabird species in the oceanic Pacific (Joyce and Ballance)
- Comparability evaluation for U.S. and Mexico fisheries that interact with North Pacific loggerhead turtles to inform IA regarding MSRA certification process (Seminoff, Eguchi)
- Cetacean reproductive tract anatomy with case study of variation in ETP delphinids (Mesnick et al.)
- Vaquita conservation through economic incentives and technological change (Mesnick, Squires et al.)