PFMC Meeting: CEC Senate Bill 605 Sea Space Identification for Wave and Tidal Energy

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SB 605 Context Setting

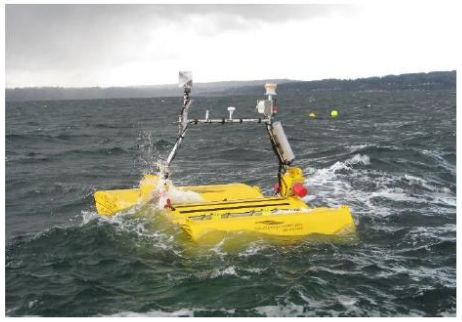
SB 605 Overview

1. **Phase One Work:** As part of the 2024 IEPR, the Commission, shall evaluate the feasibility, costs, and benefits of using wave and tidal energy.
2. **Phase Two Work:** The Commission, in coordination and consultation with other state agencies, shall work with California Native American tribes, fishing communities, industry, nongovernmental organizations, and other stakeholders, to…
    1. Identify suitable sea space for offshore wave energy and tidal energy projects in state and federal waters
    2. Identify measures that would avoid, minimize, and mitigate environmental and ecosystem impacts and use conflicts, and for monitoring and adaptive management for offshore wave energy and tidal energy projects

Status of Technology

Figure 2: Examples of Point Absorber Wave Energy Converters

CalWave xWave™
Source: CalWave



C-Power SeaRay
Source: C-Power

CorPower Ocean C4
Source: CorPower

Fred. Olsen BOLT Lifesaver
Source: Fred. Olsen

Northwest Energy Innovations Azura
Source: Northwest Energy Innovations

Oscilla Power Triton-C
Source: Oscilla Power

Figure 6: Examples of AxialFlow Turbines

Verdant Power RITE Project
Source: Verdant Power

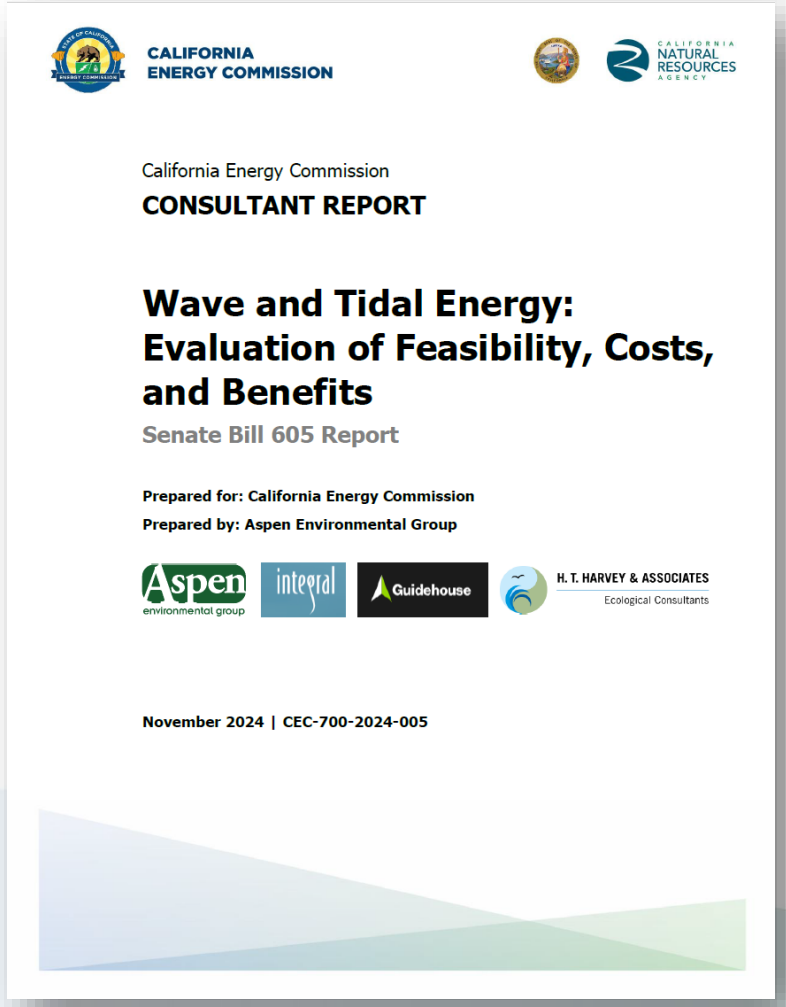
MeyGen Project by SAE Renewables
Source: SAE Renewables

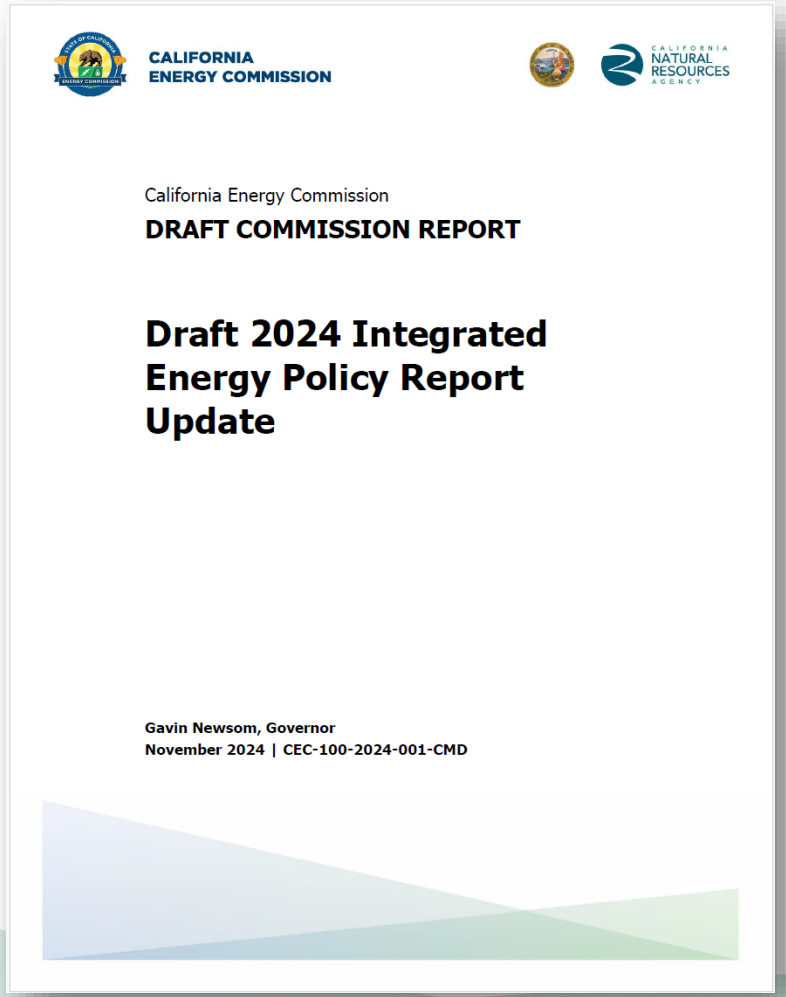
Figure 7: Crossflow Turbine Examples

Ocean Renewable Power Company TidGen
Source: Ocean Renewable Power Company

Mavi Innovations crossflow turbine
Source: Mavi Innovations

Reports Published to Date





Wave and Tidal Energy Resources & Deployment Constraints

Sea Space Findings

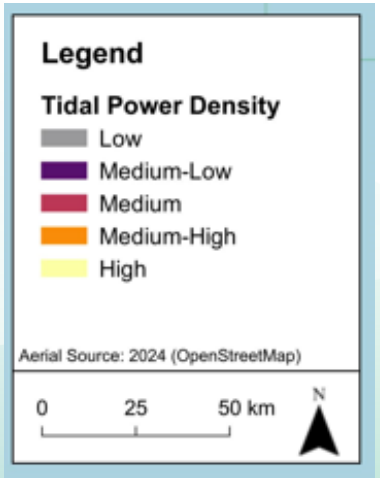
- Distributed energy resources are more feasible in the near-term than utility scale projects
- Wave energy is highest in the north, and tidal energy is available near major estuaries and bays
- Wave energy resource is more abundant in CA than tidal energy
- Unlikely that moored Wave Energy Converters (WECs) will be deployed in water depths greater than 100 meters or greater than 10 nm from the California shoreline
  - potential for installations near offshore islands or integration of WECs with offshore wind energy infrastructure
- Considerations to technology deployment include existing infrastructure avoidance, marine protected areas, existing ocean users, and environmental considerations

Sea Space Methodology

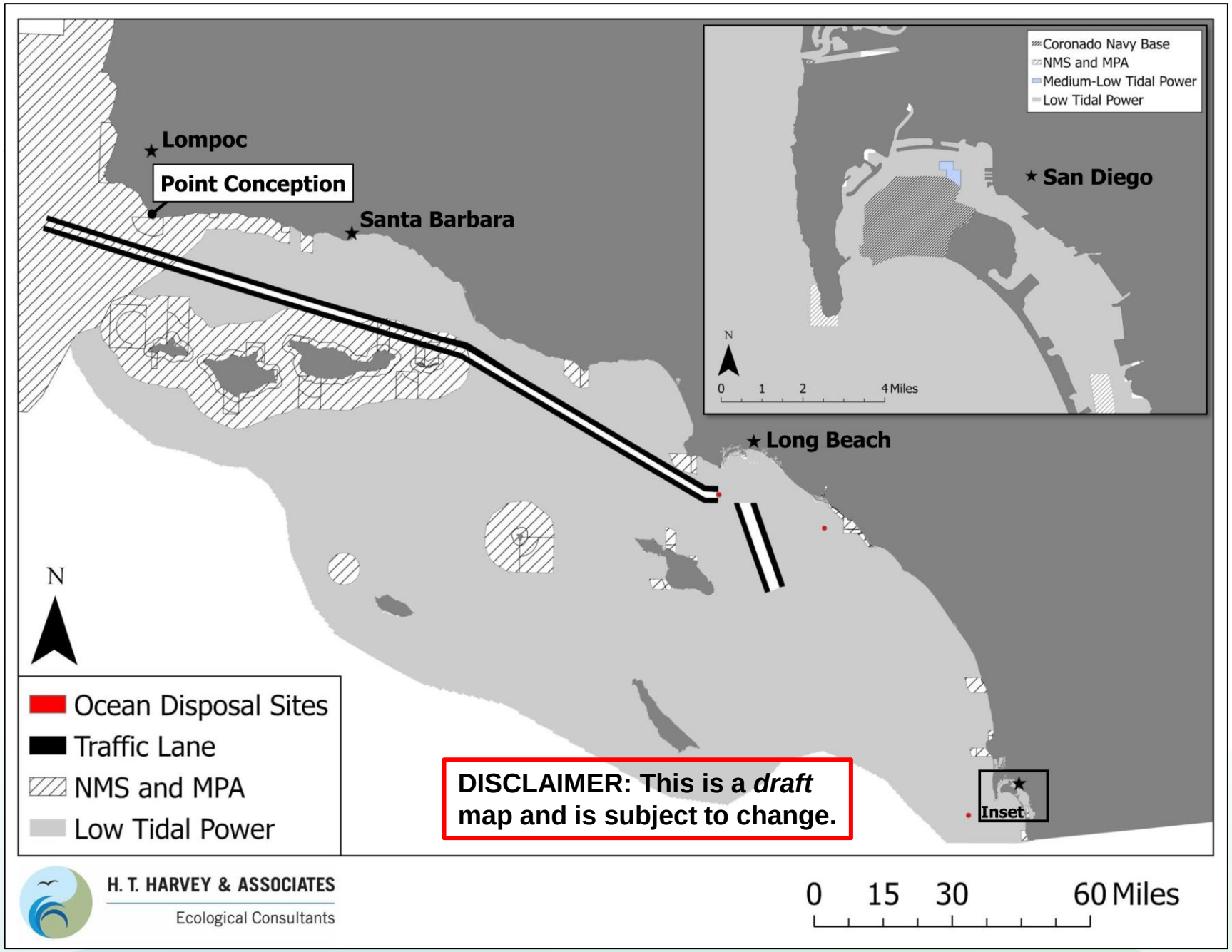
- Resource analysis summarized by region, water depth, and proximity to shore using data from NREL's Marine Energy Atlas
- This report summarizes the theoretical resource potential
- Analysis focuses on resource availability with consideration to exclusion zones
  - Exclusions: offshore disposal sites, BOEM wind leases and planning areas, oil and gas planning and lease areas, submarine cables, submarine pipelines, munitions areas, defense areas, danger zones, and protected areas, but does not include National Marine Sanctuaries
- Wave and tidal energy statistics are reported in this report for three regions:
  - Southern California (from the Mexico border north to Point Conception)
  - Central California (from Point Conception north to Bodega Bay)
  - Northern California (from Bodega Bay north to the Oregon border)
- Analysis of available energy resources is restricted to waters equal to or less than 200 meters deep

Tidal Energy Resource Overview

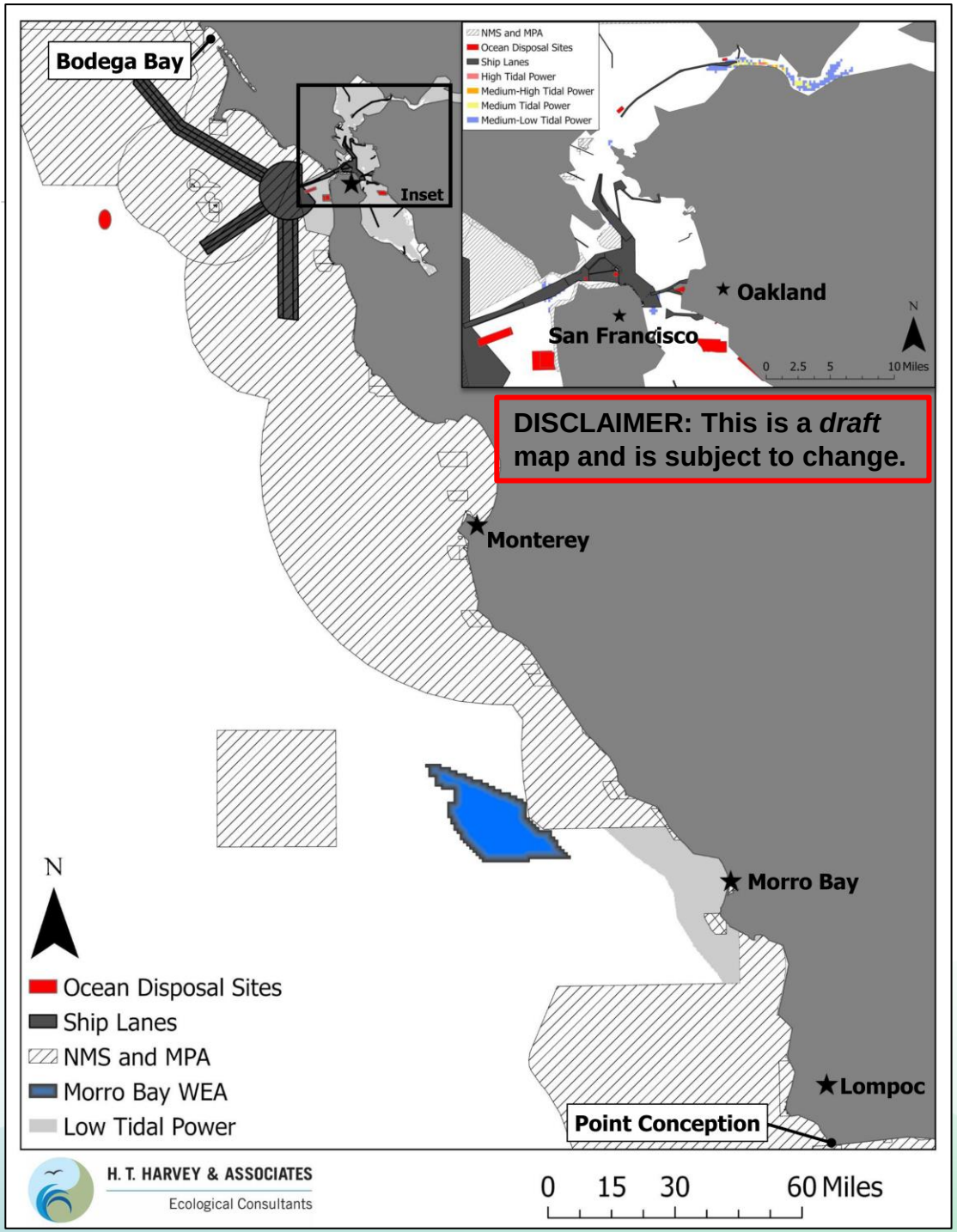
- The entrance to the San Francisco Bay is has the highest potential for commercial tidal energy deployments, representing 89 percent of the tidal energy resource for California.
  - There are known conflicts with commercial shipping
- Potential distributed energy applications may also exist for tidal energy generation at Humboldt Bay, Heckman Island/Eel River, and Tomales Bay
- Tidal power density grid cells were categorized into five bins representing increasing ranges of available tidal energy:
  - Low Tidal Power Density: <200 W/m2
  - Medium-Low: ≥200 to <400 W/m2
  - Medium: ≥400 to <600 W/m2
  - Medium-High: ≥600 to <800 W/m2
  - High Tidal Power Density: ≥800 W/m2



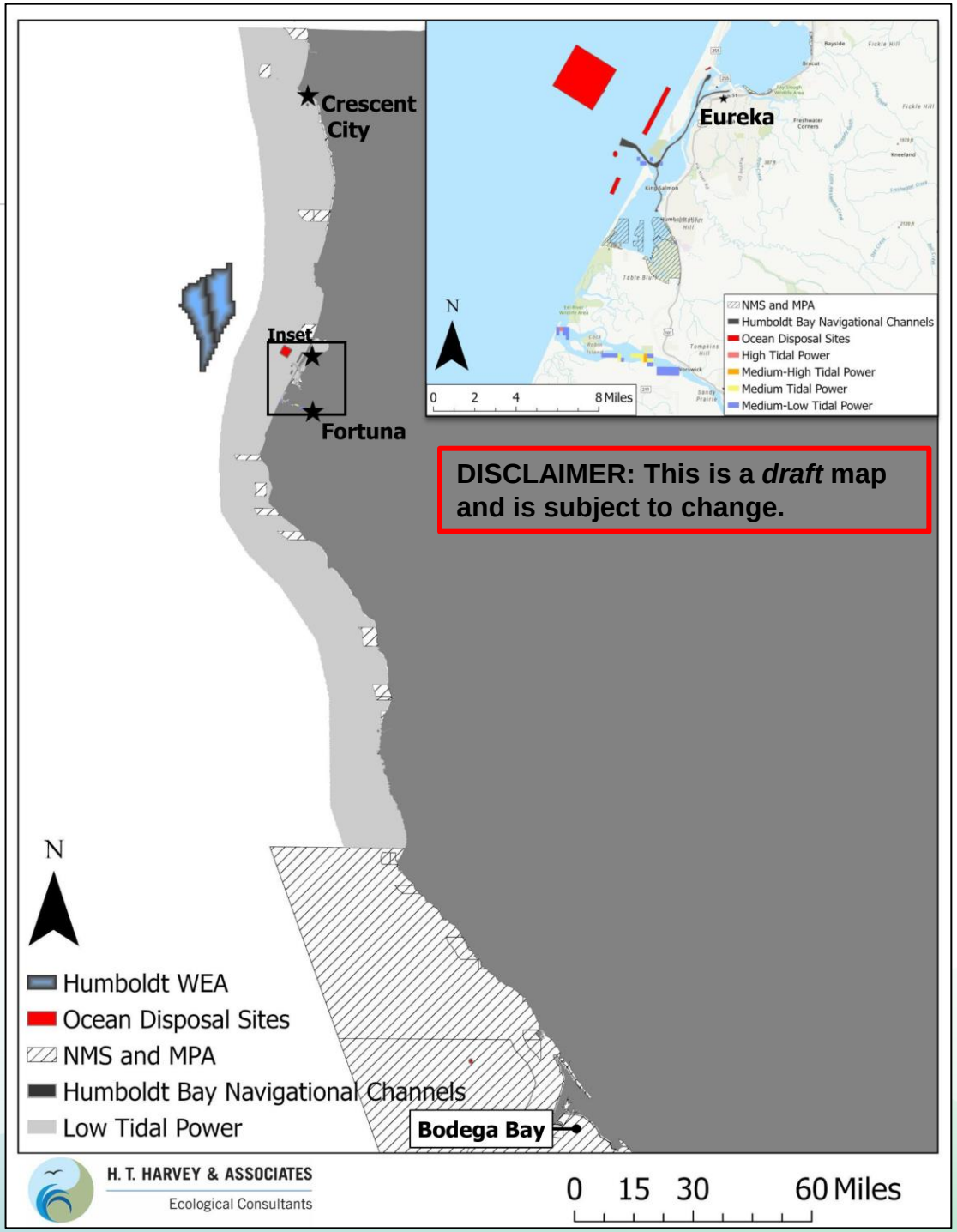
Southern California Tidal Resource Filtered By Constraints



Central California Tidal Resource Filtered By Constraints

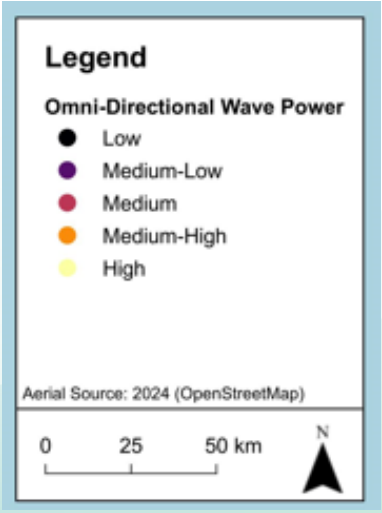


Northern California Tidal Resource Filtered By Constraints

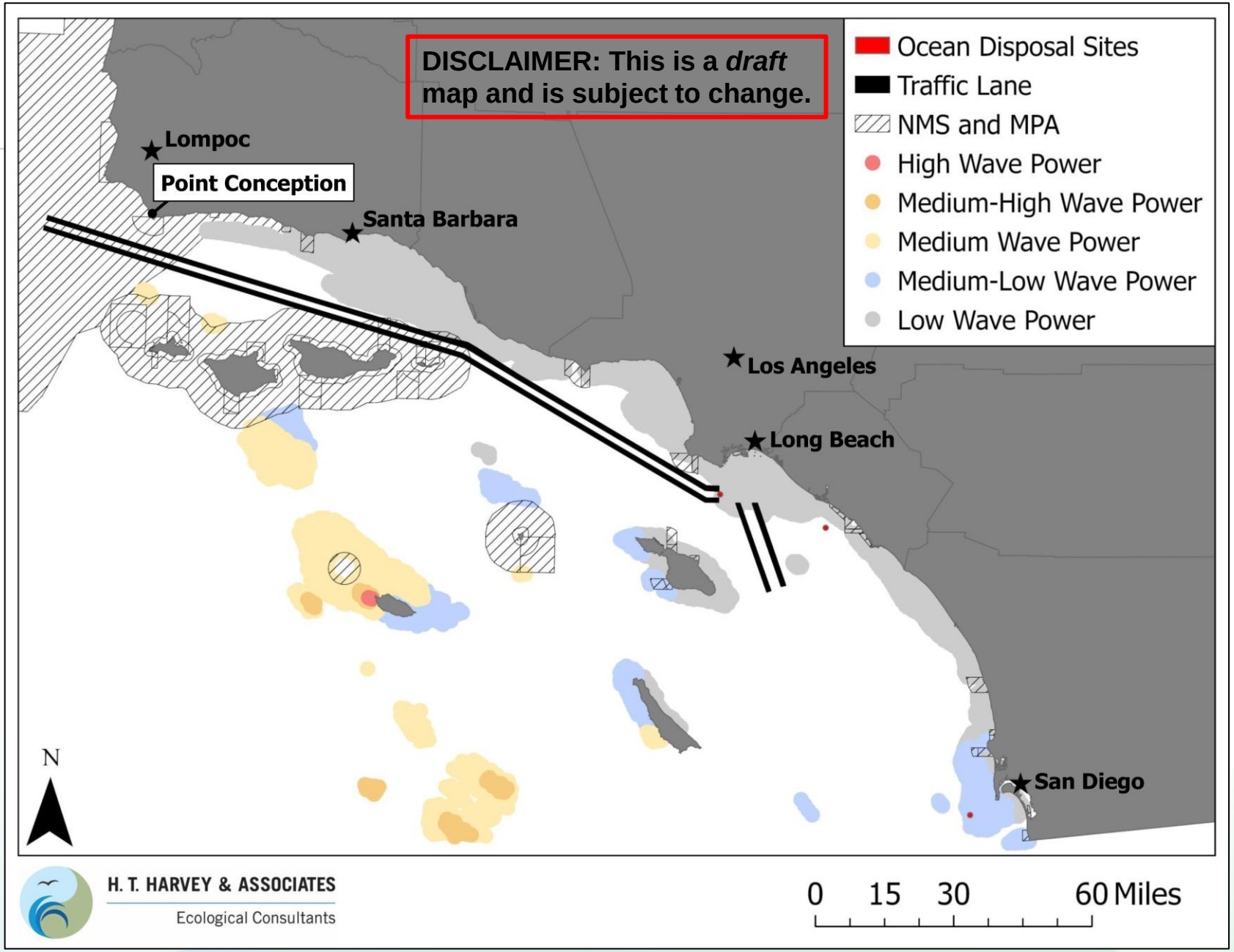


Wave Energy Resource Overview

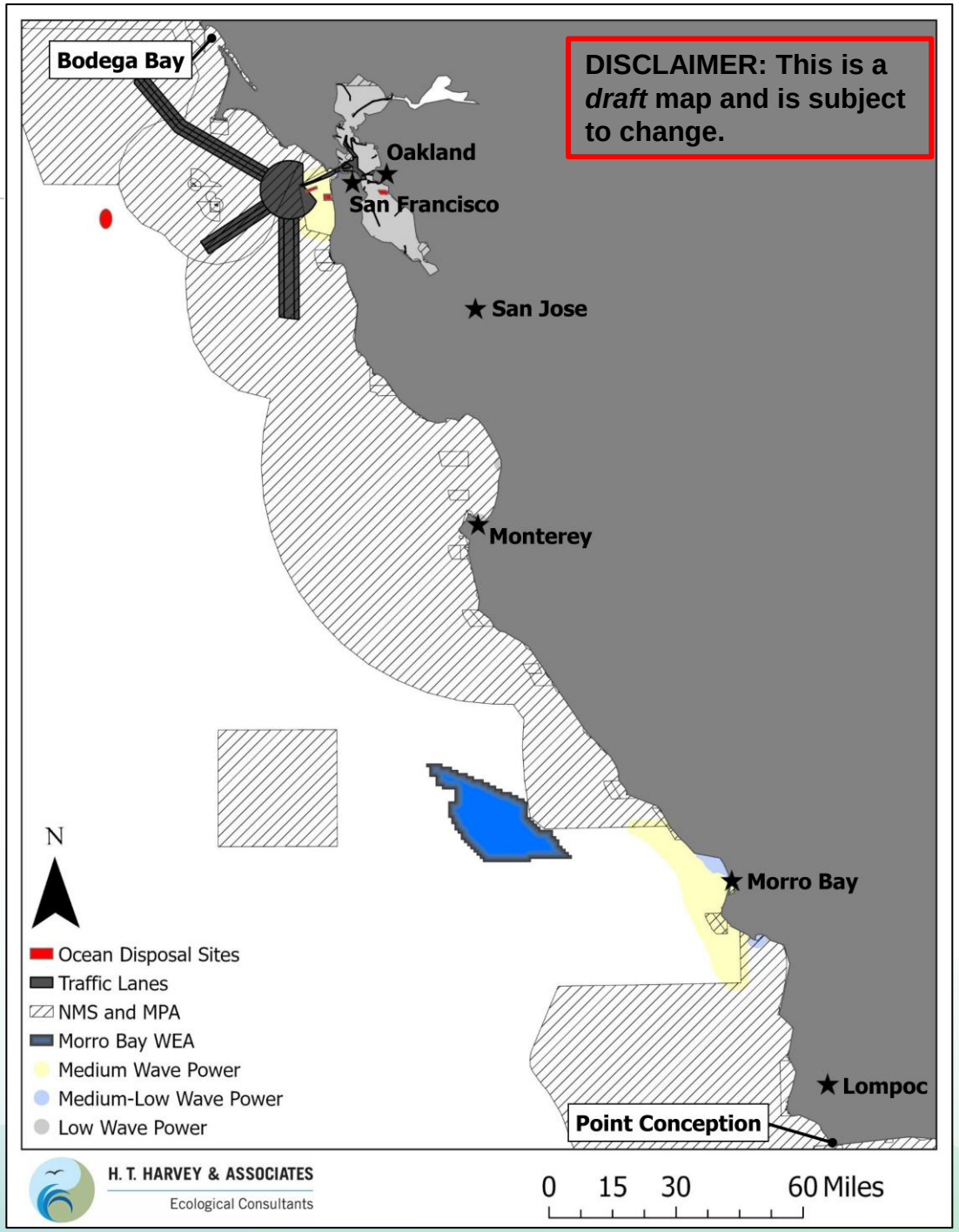
- It is likely that most wave energy converter (WEC) deployments off the coast of California will occur within 10 nautical miles (nm) of the California shoreline and within waters less than 100m depth.
- Analysis limitation: fine-resolution models are typically unavailable for water depths less than 50 m, where many WECs are likely to be deployed (devices integrated with coastal structures).
  - Wave energy at the point of installation must be estimated through additional wave modeling.
- Wave power density grid cells were categorized into five bins representing increasing ranges of available wave energy:
  - Low Wave Power: <10 kW/m
  - Medium-Low: ≥10 to <20 kW/m
  - Medium: ≥20 to <40 kW/m
  - Medium-High: ≥40 to <50 kW/m
  - High Wave Power: ≥50 kW/m



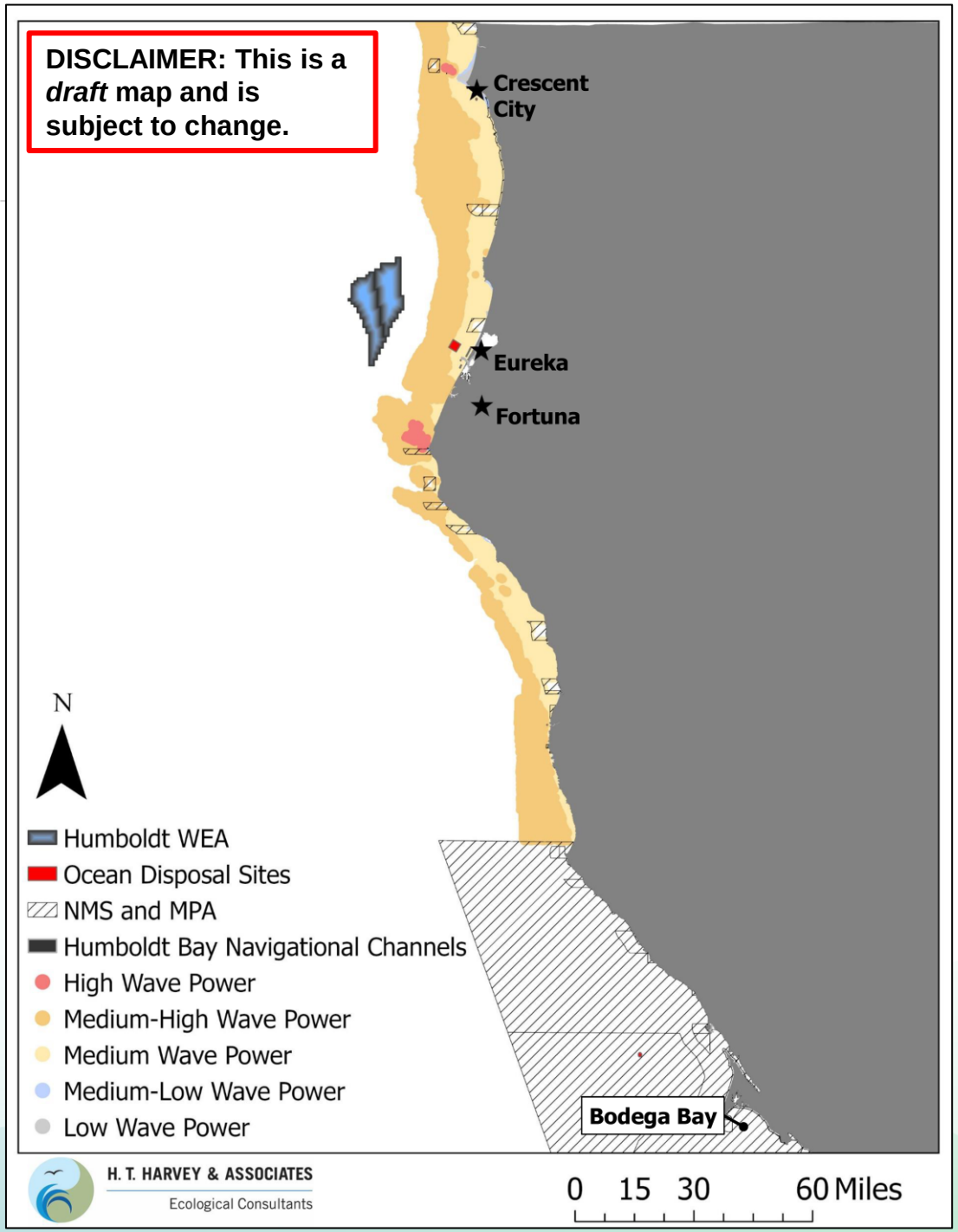
Southern California Wave Resource Filtered By Constraints



Central California Wave Resource Filtered By Constraints



Northern California Wave Resource Filtered By Constraints



Potential Sea Space Conflicts- Fisheries

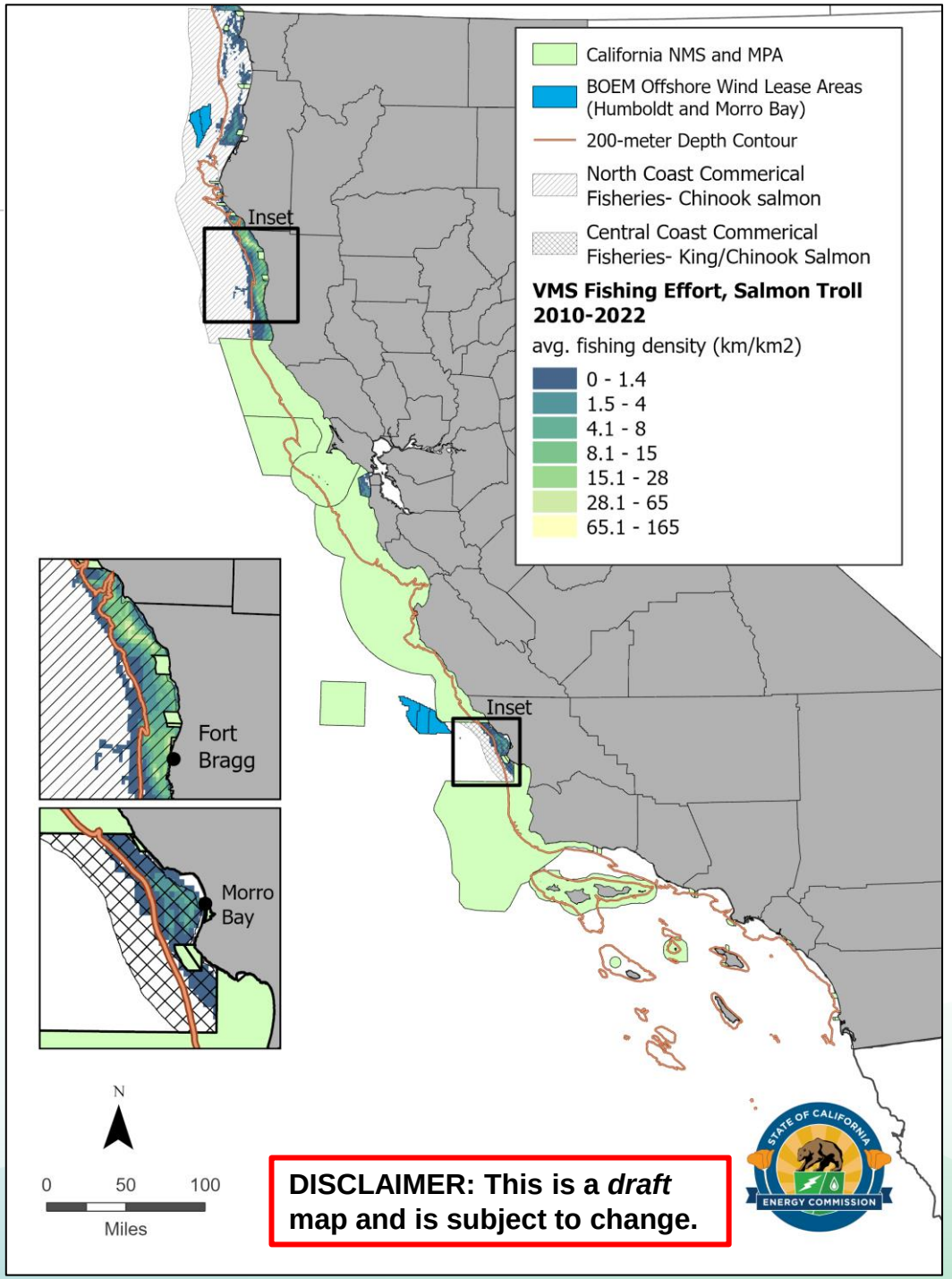
Conflicts Overview

- **Infrastructure avoidance:**
  - Subsea data/fiber optic cables
  - Pipelines
  - Oil platforms
  - Ocean disposal sites
  - oceanographic and meteorological (‘metocean’) buoys
- **Ocean Uses:**
  - Commercial shipping lanes
  - DoD military operations
  - Commercial and recreational fisheries
  - Dredging and disposal sites
  - Aquaculture (potential for co-location)
  - OSW lease areas (potential for co-location)
  - State/county beaches, recreational areas, surfing areas
- **Areas of importance to California Native American tribes**
- **Environmental Considerations:**
  - National Marine Sanctuaries
  - Marine Reserves, Conservation Areas, and other Marine Protected Areas (MPAs)
  - Critical habitats for endangered species
  - Biologically Important Areas (e.g. marine mammal feeding areas)
  - Essential Fish Habitat and Sensitive Benthic Habitats (e.g. rocky reefs)
  - Marine organisms: marine mammals, fish, seabirds, sea turtles (e.g. sensitive habitats, migratory routes)

Commercial Fisheries Maps, Salmon

Data sources:

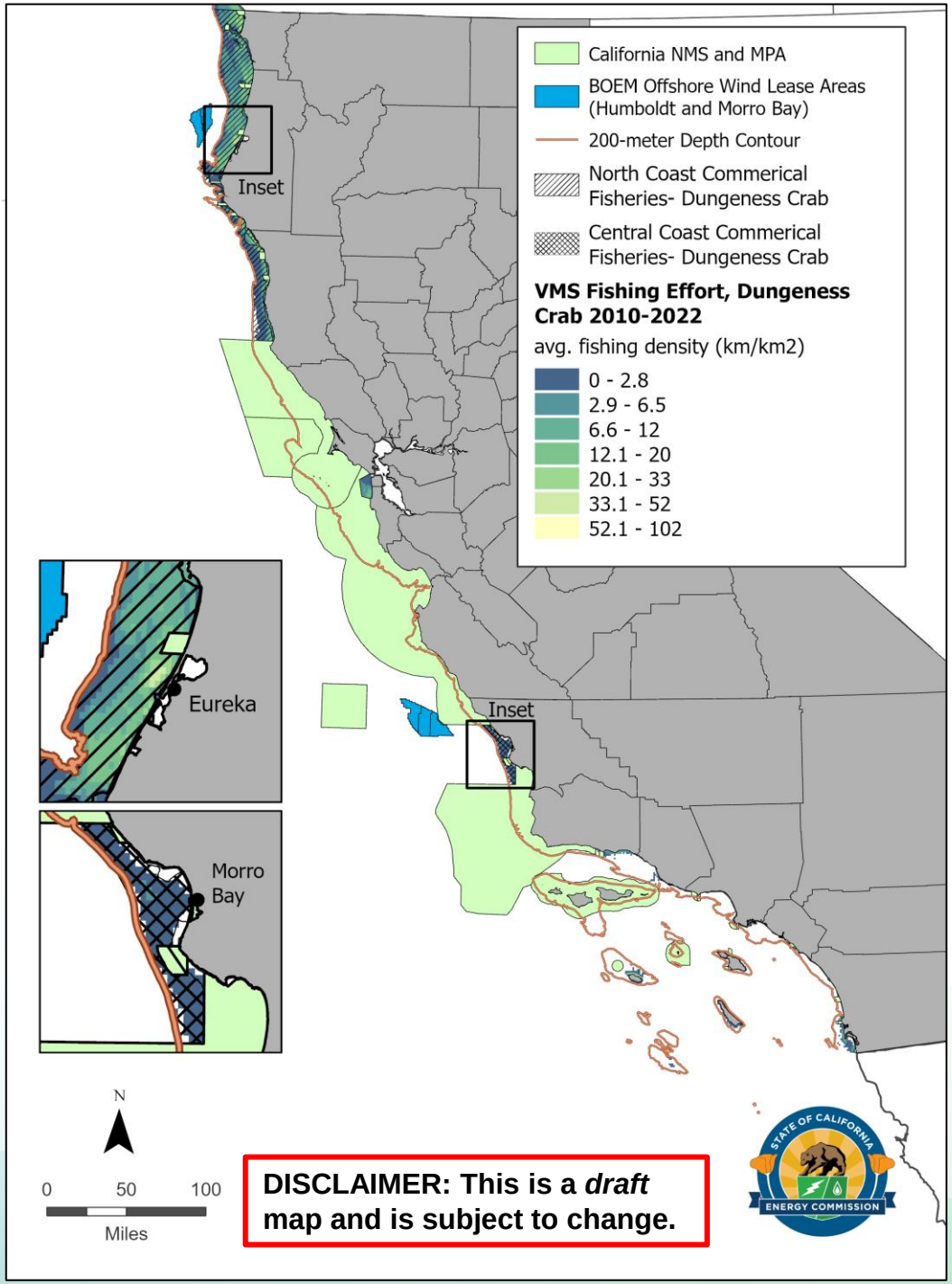
- VMS Fishing Effort- Salmon Troll
- North Coast Fisheries Mapping Project- Chinook Salmon
- Central Coast Fisheries Mapping Project- King/Chinook Salmon



Commercial Fisheries Maps, Dungeness Crab

Data sources:

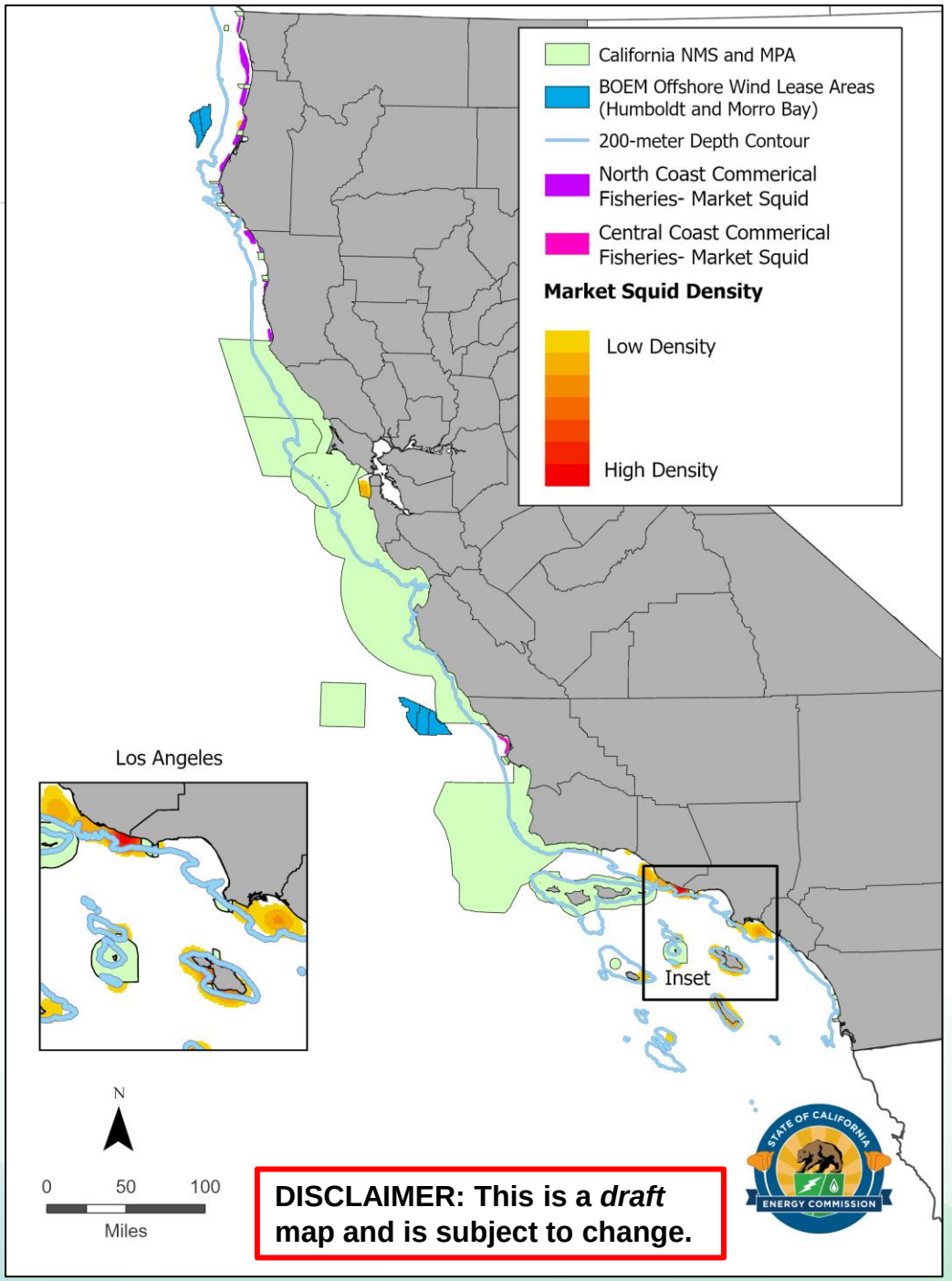
- VMS Fishing Effort- Dungeness Crab
- North Coast Fisheries Mapping Project- Dungeness Crab
- Central Coast Fisheries Mapping Project- Dungeness Crab



Commercial Fisheries Maps, Market Squid

Data sources:

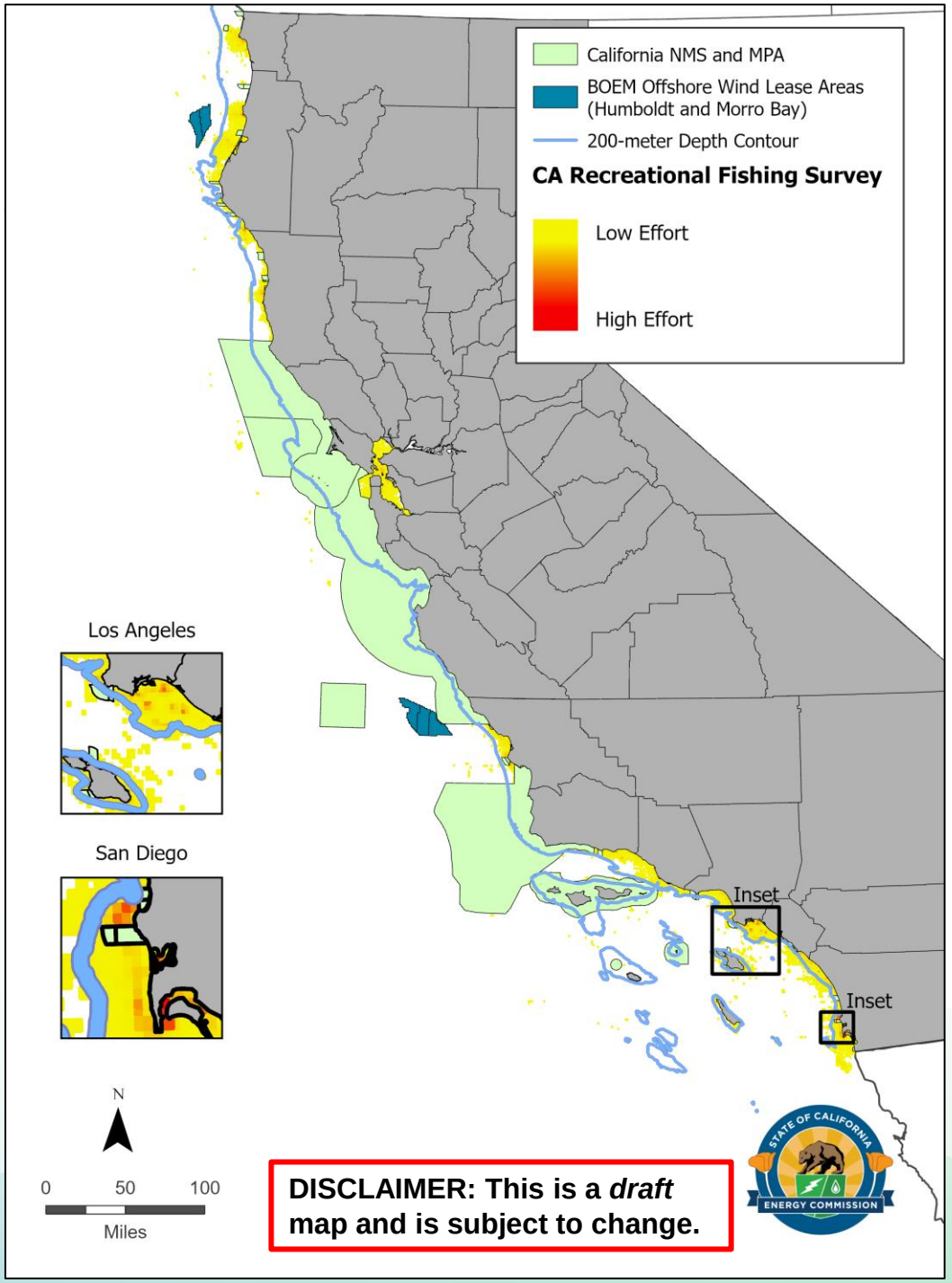
- Market Squid catch density using CDFW logbook data
- North Coast Fisheries Mapping Project- Market Squid
- Central Coast Fisheries Mapping Project- Market Squid



Recreational Fisheries Maps

Data Source:

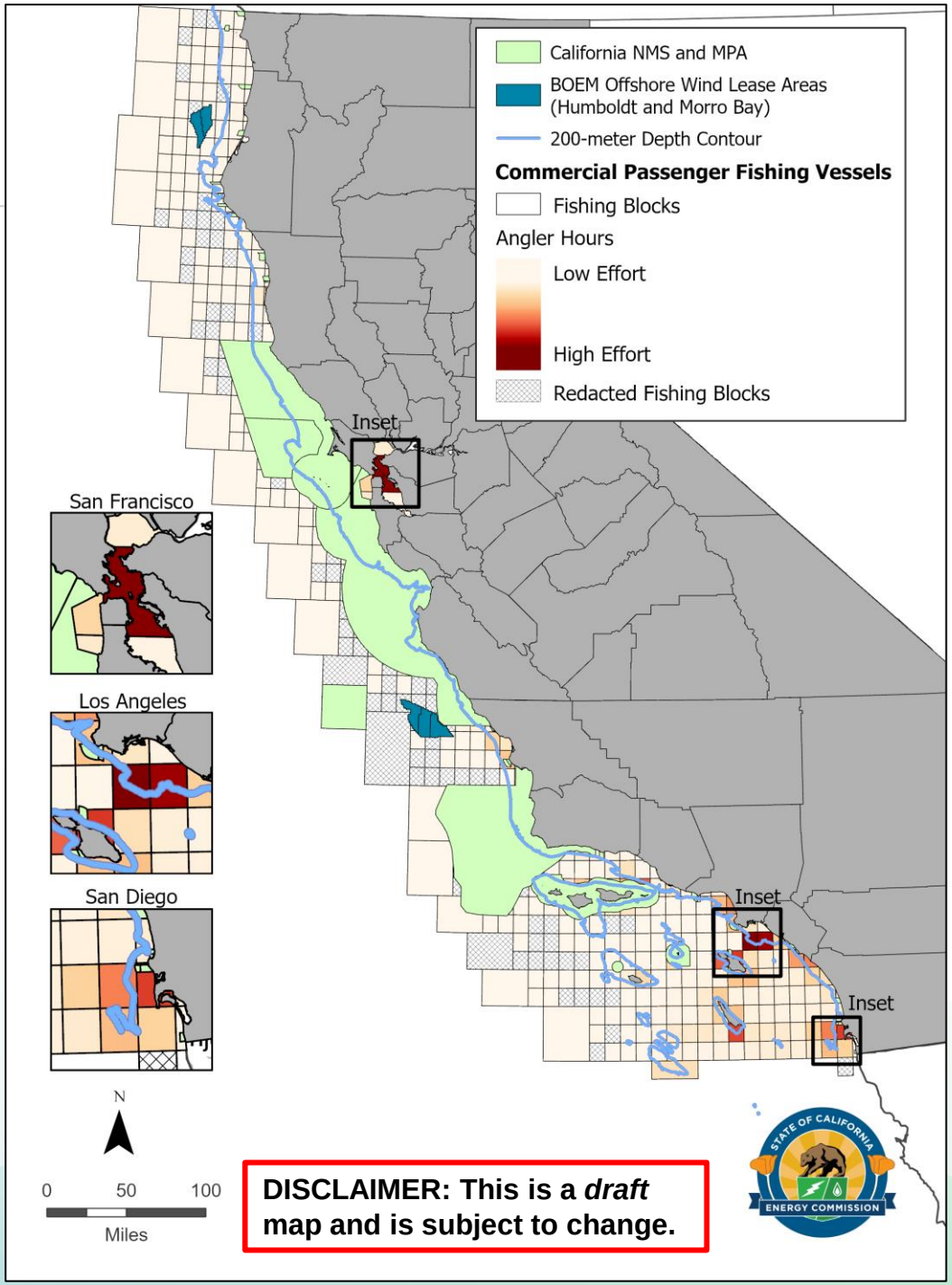
- California Recreational Fishing Survey (CRFS)- representing recreational fishing effort (CDFW data)



Recreational Fisheries Maps

Data Source:

- Commercial Passenger Fishing Vessels (CPFV)- Charter boat angler hours (CDFW data)

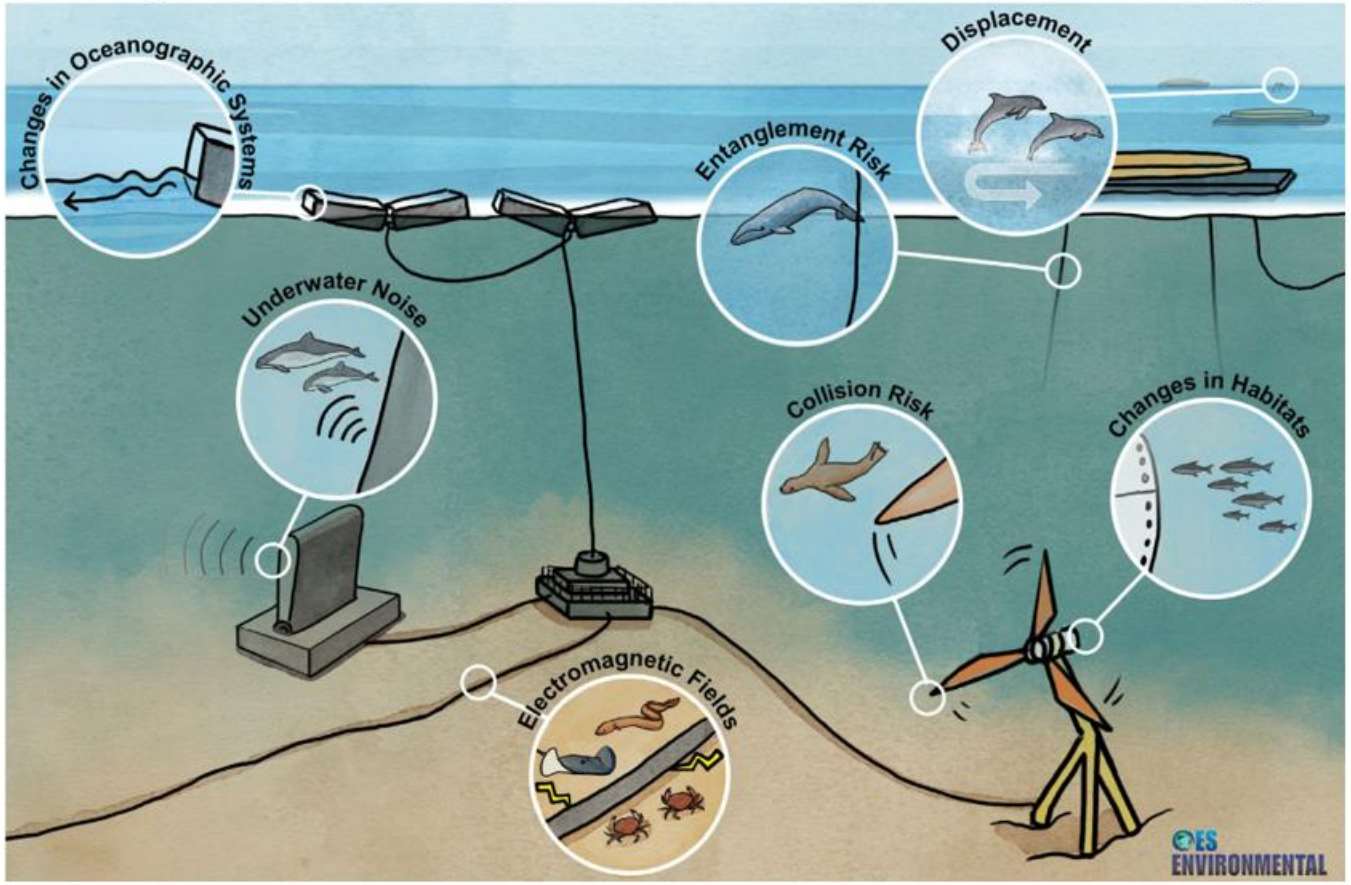


Potential Sea Space Conflicts & Mitigation Measures

Potential Environmental Impacts and Protective Measures

1. Collision, Entrapment, Impingement
2. Underwater noise
3. Electromagnetic fields (EMF)
4. Changes in habitats
5. Entanglement
6. Changes in oceanographic systems
7. Displacement

Figure 15: Stressor-receptor Interactions and Marine Renewable Energy



Stressor-receptor interactions potentially arising from various marine renewable energy devices.

Source: Copping et al. (2024)

Impacts to Commercial and Recreational Fisheries

- Impacts are still uncertain since this analysis does not designate areas for projects
- Impacts and protective measures are contingent upon actual layout and footprint of the project relative to fishing activities
- Potential impacts we can draw from AB 525 Offshore Wind Energy Strategic Plan:
  - Lost or reduced access to fishing areas- displacement (short term/long term loss of fishing grounds)
  - Gear loss or damage
  - Vessel safety concerns- collision with marine energy infrastructure
  - Increased travel time/costs for fishermen if they have to travel around arrays
  - Impacts from port activities- competition for port access
  - Disruption of fisheries data collection

Next Steps on SB 605 Work

March 2025
- Publish Draft Phase 2 Consultant Report on Sea Space, mitigation measures, monitoring strategies

March 2025
- CEC Public Workshop on Phase 2 Report

Q3 2025
- Formal SB 605 report to Governor's Office and Legislature

Resources:
- CEC webpage for SB 605: SB 605 Wave and Tidal Offshore Renewable Energy
- Contact: Danielle.Mullany@energy.ca.gov