APPENDIX C

Terrestrial and Marine Biological Resource Information

Appendix C1 Resource Agency Coordination
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APPENDIX C1 RESOURCE AGENCY COORDINATION

The ICF terrestrial biological team coordinated with relevant resource agencies to discuss sensitive biological resources expected within the terrestrial biological study area (BSA). A summary of agency communications and site visits is provided below.

California Department of Fish and Wildlife: On July 30, 2020, ICF held a conference call with Greg O'Connell (Environmental Scientist) and Corianna Flannery (Environmental Scientist) to discuss Project design and potential biological concerns regarding the Eureka Subsea Fiber Optic Cables Project (Project). Mr. O'Connell discussed the importance of considering the western bumble bee. Ms. Flannery discussed the importance of the hard ocean floor substrate and asked how the cable would be secured to the ocean floor to reduce or eliminate scour. The western bumble bee has been evaluated in the *Biological Resources* section of the main document, and direct and indirect impacts are avoided. The *Project Description* describes in detail how the cable would be installed on the ocean floor, the importance of the hard bottom substrate, and the need for avoidance.

Consultation Outcomes:

- The Project was designed to avoid hard bottom substrate, and RTI Infrastructure (RTI) conducted surveys of the ocean floor to ensure that proper routing of the cable would occur.
- Ms. Flannery will be copied on all communications with the National Marine Fisheries Service

California Department of Fish and Wildlife: On August 7, 2020, ICF held a conference call with Greg O'Connell to discuss a site assessment and survey approach for the western bumble bee. Because capture of insects was not part of the sampling design, an incidental take permit was not necessary. Mr. O'Connell stressed the importance of nesting and over-wintering habitat but was not concerned with the bee's flight period. Mr. O'Connell described an approach to assess the cable landing site 1 year prior to ground disturbance to determine the presence/absence of western bumble bee.

Consultation Outcomes:

- Mr. O'Connell provided literature for review that was used to develop the survey and assessment approach.
- A survey was designed that involved two separate site visits during the appropriate time and weather conditions to observe and photograph foraging insects.

U.S. Fish and Wildlife Service (USFWS): On August 7, October 9 and 13, 2020, ICF corresponded via email with John Hunter, of the Arcata U.S. Fish and Wildlife Office.

Consultation Outcomes:

- August 7 – Mr. Hunter stated that he would be in contact to discuss the project in more detail.
- October 9 – On behalf of RTI, ICF emailed Mr. Hunter a letter requesting technical assistance for the federally endangered beach layia (*Layia carnosa*) and federally threatened western snowy plover (*Charadrius nivosus nivosus*). ICF requested that USFWS concur with our no effect (NE) determination.
- October 13 – Mr. Hunter responded to the technical assistance letter emailed on October 9. Mr. Hunter asked whether the Project was private or had a federal nexus. If private, he stated that "This might be a no take at this point" and that a technical assistance letter would be issued. However, if there was a federal nexus, the process for a no effect concurrence would be different. ICF's Steve Yonge emailed Mr. Hunter and stated that RTI had yet to contact the U.S. Army Corps of Engineers (USACE) to discuss the Project and whether the terrestrial portion of the Project would be included in the Clean Water Act 404 permit that RTI will apply for. Mr. Hunter stated that the USFWS does not issue technical assistance letters for NE determinations but stated "It would seem to us that your reasoning for a potential NE determination looks sound." Mr. Hunter requested that ICF inform him of the permitting approach the USACE takes and whether a federal nexus is identified.

California Department of Fish and Wildlife: On August 19, 2020, ICF met Greg O'Connell at the cable landing site to discuss the potential for the western bumble bee to occur. We reviewed the area for nesting and over-wintering habitat, and discussed the proposed methods to determine whether western bumble bees were using the site. We explained our sample approach and the photography taken to capture images of foraging insects that would be used for identification to be performed by an entomologist. We discussed potential temporary and permanent impacts, and installation of temporary fencing around the work area during construction. Mr. O'Connell thought impacts on the dune mat community may require restoration; he provided example restoration opportunities and recommended that ICF contact Laurel Goldsmith with USFWS for assistance with dune restoration concepts.

Consultation Outcomes:

- Mr. O'Connell thought it was sufficient to photograph insects and then have the photographs reviewed by an entomologist.
- Permanent impacts at the cable landing site would be minimal and would involve installation of four vault boxes.

National Marine Fisheries Service (NMFS): From August 5 through August 31, 2020, ICF corresponded via email with multiple staff members who support the West Coast and Pacific Islands NMFS regions. ICF clarified the location of the cable landing site and discussed the nexus for consultation that would be initiated by the USACE as part of Nationwide Permit #12.

On October 21, 2020, ICF held a conference call with representatives from both the NMFS West Coast and Pacific Islands Regional offices. We discussed the four phases of the Project, potential effects of the Project to be addressed in the biological assessment (BA) and essential fish habitat (EFH) assessment, and the permitting approach.

Consultation Outcomes:

- Developed a list of NMFS staff to coordinate with and discuss an approach to review and analyze the Project that spans the NMFS West Coast and Pacific Islands regions.
- Agreed to engage the USACE to determine the most appropriate way to permit the Project through the Clean Water Act 404 process.
- ICF on behalf of RTI would begin to prepare the draft BA and EFH assessment that would support formal consultation under Section 7 of the federal Endangered Species Act.

Table C1-1. Special-Status Wildlife and Fish Species and Their Potential to Occur in the Terrestrial Biological Study Area (BSA)

Common Name Scientific Name	Legal Status Federal/ State[a]	General Range and Habitat Description	Potential to Occur in the BSA
Southern torrent salamander *Rhyacotriton variegatus*	–/SSC	Found in coastal drainages from southern Mendocino County north to Oregon; prefers cold shaded streams and seeps, often with rocks and talus, usually on north-facing slopes.	None – No suitable habitat present.
Pacific tailed frog *Ascaphus truei*	–/SSC	Occurs in coastal northern California and inland to Big Bend in Shasta County and north in the Cascade Mountains. Restricted to montane cold, clear, rocky perennial streams in wet forests; tadpoles require water below 15 degrees Celsius.	None – No suitable habitat present
Northern red-legged frog *Rana aurora*	–/SSC	Occurs in coastal northern California; Mendocino County through Oregon and Washington; humid forests, woodlands, and streams with plant cover. Often found in woods adjacent to streams. Breeding habitat is in permanent water sources; lakes, ponds, reservoirs, slow streams, marshes, bogs, and swamps.	None – No suitable habitat present
Foothill yellow-legged frog *Rana boylii*	–/SSC	Occurs throughout the North and South Coast Ranges, south to the Transverse Range, across northern California to the west slope of the Cascade Range, and south through the foothills of the Sierra Nevada. Inhabits forest streams and rivers (both perennial and intermittent) with sunny, sandy, and rocky banks, with deep pools, and shallow riffles.	None – No suitable habitat present
Western pond turtle *Emys marmorata*	–/SSC	Occurs throughout California west of the Sierra-Cascade crest; found from sea level to 6,000 feet; occupies ponds, marshes, rivers, streams, and irrigation canals with muddy or rocky bottoms.	None – No suitable habitat present

Table C1-1. Continued

Common Name Scientific Name	Legal Status Federal/ State[a]	General Range and Habitat Description	Potential to Occur in the BSA
White-tailed kite *Elanus leucurus*	–/FP	Occur in savanna, open woodlands, marshes, desert grassland, partially cleared lands, and cultivated fields throughout the West; often nest in isolated trees in open-country or forest edges.	Moderate – Suitable nesting and foraging habitat present. Not observed during the July 10, 2020 habitat-based field survey.
Bald eagle *Haliaeetus leucocephalus*	–/SE, FP	Nests in large, old-growth, or emergent live tree with open branchwork. Nests typically located 50 to 200 feet above ground. Forages primarily in large inland fish-bearing waters with adjacent large trees or snags, and occasionally in uplands with abundant rabbits, other small mammals, or carrion. Breeding range includes the Sierra Nevada, Cascade Range, and portions of the Coast Ranges; winter range expands to include most of the State.	None – No suitable nesting or foraging habitat present
Northern harrier *Circus cyaneus*	–/SSC	Widespread throughout North America in wide-open grasslands, marshes, or fields; breed in freshwater and brackish marshes; nest on the ground and usually in a dense clump of vegetation or grass.	Moderate – Suitable nesting and foraging habitat present. Not observed during the July 10, 2020 habitat-based field survey.
Yellow rail *Coturnicops noveboracensis*	–/SSC	Isolated western breeding populations exist in south-central Oregon and, apparently, in adjacent northern California; occurs in shallow marshes, and wet meadows.	None – No suitable habitat present
California Ridgway's rail *Rallus obsoletus*	FE/SE	Found in saltwater marshes, freshwater marshes, and mangrove swamps in California, Arizona, Nevada, and coastal western Mexico; nests in clumps of vegetation or in shrubs just above ground level.	None – No suitable habitat present
Northern spotted owl *Strix occidentalis caurina*	FT/ST	Occurs in coniferous, hardwood, and mixed forests with complex, multi-layered structure, large-diameter trees, and high-canopy closure.	None – No suitable habitat present

Table C1-1. Continued

Common Name Scientific Name	Legal Status Federal/ State[a]	General Range and Habitat Description	Potential to Occur in the BSA
Western snowy plover *Charadrius alexandrinus nivosus*	FT/SSC	Found along the West Coast; breeds above the high tide line on coastal beaches, sand spits, dune-backed beaches, sparsely-vegetated dunes, beaches at creek and river mouths, and salt pans. Known to nest and winter approximately 500 feet west of the CLS.	None – No suitable habitat present.
Mountain plover *Charadrius montanus*	–/SSC	Winter in California; nest across the western Great Plains and Rocky Mountain states; most of California population winters in the San Joaquin and Imperial Valleys in California; prefers dry habitat with short grass, pastures, or bare ground.	None – No suitable habitat present
Marbled murrelet *Brachyramphus marmoratus*	FT/SE	Occurs in coastal western United States., a small seabird that nests in California in stands of old growth redwood and other types of conifer forest. Suitable foraging habitat west of the CLS in the Pacific Ocean.	None – No suitable habitat present.
Yellow-billed cuckoo *Coccyzus americanus occidentalis*	FT/SE	Nests along the upper Sacramento, lower Feather, south fork of the Kern, Amargosa, Santa Ana, and Colorado Rivers. Requires wide, dense riparian forests/woodlands with a thick understory of willows for nesting; sites with a dominant cottonwood overstory are preferred for foraging; may avoid valley-oak riparian habitats where scrub jays are abundant.	None – No suitable nesting or foraging habitat present.
Bank swallow *Riparia riparia*	–/ST	Uncommon breeding season resident in northern and central California; found in valleys and coastal areas where alluvial soils occur; nests colonially in vertical dirt or sand banks, usually along rivers or ponds.	None – No suitable habitat present.

Table C1-1. Continued

Common Name Scientific Name	Legal Status Federal/ State[a]	General Range and Habitat Description	Potential to Occur in the BSA
Townsend's big-eared bat *Corynorhinus townsendii*	–/SSC	Primarily roost in caves and cave-like roosting habitat, such as tunnels and mines. Very sensitive to disturbances and may abandon a roost after one on-site visit. Reported to use buildings in the northern and coastal portions of range. Also reported to use bridges and hollow trees as roost sites. In California, occurs in inland deserts, moist cool redwood forests, oak woodlands of the inner Coast Ranges and Sierra Nevada foothills, and low to mid-elevation mixed conifer forests.	None – No suitable habitat present.
White-footed vole *Arborimus albipes*	–/SSC	Endemic to the coastal coniferous forests of Northern California and Oregon. Rare and poorly known. Thought to inhabit redwood groves.	None – No suitable habitat present.
Sonoma tree vole *Arborimus pomo*	–/SSC	Endemic to California; from Sonoma County, north through Mendocino, Humboldt, and western Trinity counties to the South Fork of the Smith River, Del Norte County; poorly known; occurs in mixed evergreen forests; may prefer wet and mesic old-growth Douglas-fir forest.	None – No suitable habitat present.
Humboldt marten *Martes caurina humboldtensis*	FT/SE	Known from Del Norte and Humboldt Counties, with their range extending into Mendocino and northern Sonoma Counties. Found in coastal old-growth forests.	None – No suitable habitat present
Fisher, West Coast DPS *Pekania pennanti*	FT/SSC	Distributed throughout the northern Coast Ranges, Cascade Range, Klamath Range and southern Sierra Nevada. Inhabits forests with diverse successional stages with mostly mid- and late-successional stages and high percent canopy closure. Requires tree or snag cavities for denning, in large-diameter trees.	None – No suitable habitat present.

Table C1-1. Continued

Common Name Scientific Name	Legal Status Federal/ State[a]	General Range and Habitat Description	Potential to Occur in the BSA
Western bumble bee *Bombus occidentalis*	–/SCE	Populations of central California, Oregon, Washington and southern British Columbia have largely disappeared. Generalist foragers using a variety of flower types. Found in a variety of habitat types and forage/pollinate a wide range of plant species. Construct hives in underground burrows or crevices.	Low – Suitable foraging habitat present, but not observed during August 12 and 19, 2020 habitat assessment and surveys.
Coastal cutthroat trout *Oncorhynchus clarkii*	–/SSC	Found in small, low gradient coastal streams that are cool, shaded, with cover. Also found in estuaries. They are anadromous, but strongly associated with freshwater.	None – No aquatic habitat present
Tidewater goby *Eucyclogobius newberryi*	FE/SSC	Requires fresh or brackish water, and/or mud substrates to burrow into. Does best in tidally muted or seasonally disconnected lagoons, estuaries, or sloughs.	None – No aquatic habitat present

Sources: Jennings and Hayes 1994; Hunter et al. 2005; Moyle 2002; Shuford and Gardali 2008; Thomson et al. 2016; Zeiner et al. 1990a, 1990b; Xerces Society, Defenders of Wildlife, and Center for Food Safety 2018

Terms:

CNDDB = California Natural Diversity Database

DPS = Distinct Population Segment

Notes:

[a] Status explanations:

Federal

FT = Listed as threatened under the federal Endangered Species Act

FE = Listed as endangered under the federal Endangered Species Act

– = No listing

State

SE = Listed as endangered under the California Endangered Species Act

ST = Listed as threatened under the California Endangered Species Act

SCE = Candidate for listing as endangered under the California Endangered Species Act

SSC = Species of special concern in California

FP = Fully Protected under the California Fish and Game Code

– = No listing

Table C1-2. Special-Status Plant Species with Potential to Occur in the Terrestrial Biological Study Area

Scientific Name Common Name	Legal Status[a] Fed/State/ CRPR	Habitat Requirements	Blooming Period	Potential for Occurrence and Rationale
Abronia umbellata var. *breviflora* Pink sand-verbena	–/–/1B.1	Close to the ocean in coastal dunes and coastal strand; 0–10 meters	Jun–Oct	None – Known CNDDB occurrences nearby
Astragalus pycnostachyus var. *pycnostachyus* Coastal marsh milk-vetch	–/–/1B.2	Mesic sites in dunes, along streams, and in coastal salt marshes; 0–30 meters	(Apr) Jun–Oct	None – No suitable habitat present
Cardamine angulate Seaside bittercress	–/–/2B.2	North Coast coniferous forest and lower montane coniferous forest in wet areas and streambanks; 25–915 meters	(Jan) Mar–Jul	None – No suitable habitat present
Carex arcta Northern clustered sedge	–/–/2B.2	Bogs and fens in North Coast coniferous forest; 60–1,405 meters	Jun–Sep	None – No suitable habitat present
Carex leptalea Bristle-stalked sedge	–/–/2B.2	Bogs and fens, mesic meadows and seeps, marshes and swamps; below 700 meters	Mar–Jul	None – No suitable habitat present
Carex lyngbyei Lyngbye's sedge	–/–/2B.2	Brackish or freshwater marshes and swamps; 0–10 meters	Apr–Aug	None – No suitable habitat present
Carex praticola Northern meadow sedge	–/–/2B.2	Moist to wet meadows; 0–3,200 meters	May–Jul	None – No suitable habitat present
Castilleja ambigua var. *humboldtiensis* Humboldt Bay owl's-clover	–/–/1B.2	Coastal saltmarsh with *Spartina, Distichlis, Salicornia, Jaumea*, in marshes and swamps; 0–3 meters	Apr–Aug	None – No suitable habitat present
Castilleja litoralis Oregon Coast paintbrush	–/–/2B.2	Sandy sites in coastal bluff scrub, coastal dunes, coastal scrub; 15–100 meters	Jun–Jul	Low – Not observed in general area since 1918 [Calflora].
Chloropyron maritimum subsp. *palustre* Point Reyes salty bird's-beak	–/–/1B.2	Coastal salt marsh, often with *Salicornia, Distichlis, Jaumea, Spartina* up to 10 meters	Jun–Oct	None – No suitable habitat present

Table C1-2. Continued

Scientific Name Common Name	Legal Status[a] Fed/State/ CRPR	Habitat Requirements	Blooming Period	Potential for Occurrence and Rationale
Collinsia corymbosa Round-headed Chinese-houses	–/–/1B.2	Coastal dunes; 0–20 meters	Apr–Jun	Low – Not observed in general area since 1900 [Calflora].
Erysimum menziesii Menzies' wallflower	E/E/1B.1	Coastal dunes and coastal strand; 1–35 meters	Mar–Sep	Moderate – Known CNDDB occurrences nearby; iNaturalist observations of flowering nearby on March 13, 2020.
Erythronium revolutum Coast fawn lily	–/–/2B.2	Mesic sites and streambanks in bogs and fens, broadleafed upland forest, and North Coast coniferous forest; below 1,600 meters	Mar–Jul (Aug)	None – No suitable habitat present
Gilia capitata subsp. *pacifica* Pacific gilia	–/–/1B.2	Coastal bluff scrub, chaparral, coastal prairie, valley and foothill grassland; 5–1,330 meters	Apr–Aug	Low – Not observed in general area since 1948 [Calflora].
Gilia millefoliata Dark-eyed gilia	–/–/1B.2	Coastal dunes; 1–30 meters	Apr–Jul	High – Known CNDDB occurrences nearby; confirmed presence west of project site.
Hesperevax sparsiflora var. *brevifolia* Short-leaved evax	–/–/1B.2	Coastal bluff scrub, coastal dunes, and coastal prairie on sandy bluffs and flats; 0–215 meters	Mar–Jun	High – Known CNDDB occurrences nearby; confirmed presence 350 feet west of Project site.
Lasthenia californica subsp. *macrantha* Perennial goldfields	–/–/1B.2	Coastal bluff scrub, coastal dunes, and coastal scrub; 5–520 meters	Jan–Nov	Low – Foredune considered low quality habitat. Not observed from Eureka area since 1913 [Calflora].
Lathyrus japonicus Seaside pea	–/–/2B.1	Coastal dunes; 3–30 meters	May–Aug	None – No suitable habitat present

Table C1-2. Continued

Scientific Name Common Name	Legal Status[a] Fed/State/ CRPR	Habitat Requirements	Blooming Period	Potential for Occurrence and Rationale
Lathyrus palustris Marsh pea	–/–/2B.2	Moist coastal areas in bogs & fens, lower montane coniferous forest, marshes and swamps, North Coast coniferous forest, coastal prairie, and coastal scrub; 1–100 meters	Mar–Aug	None – No suitable habitat present
Layia carnosa Beach layia	E/E/1B.1	Coastal dunes and coastal scrub, on sparsely vegetated, semi-stabilized dunes, usually behind foredunes; 0–60 meters	Mar–Jul	High – Known CNDDB occurrences nearby; iNaturalist observations of flowers on April 6, 2020; confirmed presence 300 feet west of Project site.
Lilium occidentale Western lily	E/E/1B.2	Well-drained, old beach washes overlain with wind-blown alluvium and organic topsoil; usually near margins of Sitka spruce in coastal scrub, freshwater marsh, bogs and fens, coastal bluff scrub, coastal prairie, North Coast coniferous forest, marshes and swamps; 2–185 meters	Jun–Jul	None – No suitable habitat present
Montia howellii Howell's montia	–/–/2B.2	Vernally wet sites; often on compacted soil, in meadows and seeps, North Coast coniferous forest, and vernal pools; 0–835 meters	(Jan–Feb) Mar–May	None – No suitable habitat present
Oenothera wolfii Wolf's evening-primrose	–/–/1B.1	Sandy substrates, usually in mesic sites, in coastal bluff scrub, coastal dunes, coastal prairie, and lower montane coniferous forest; 3–800 meters	May–Oct	Moderate – Sandy roadside habitats present

Table C1-2. Continued

Scientific Name Common Name	Legal Status[a] Fed/State/ CRPR	Habitat Requirements	Blooming Period	Potential for Occurrence and Rationale
Puccinellia pumila Dwarf alkali grass	/–/2B.2	Coastal salt marshes, known from only two sites in Humboldt and Mendocino Counties; 1–10 meters	July	None – No suitable habitat present
Sidalcea malviflora subsp. *patula* Siskiyou checkerbloom	–/–/1B.2	Open coastal forest and roadcuts, in coastal bluff scrub, coastal prairie, and North Coast coniferous forest; 15–880 meters	Apr (May–Aug)	None – No suitable habitat present
Sidalcea oregana subsp. *eximia* Coast checkerbloom	–/–/1B.2	Near meadows, in gravelly soil, in meadows and seeps, North Coast coniferous forest, and lower montane coniferous forest; 5–1,350 meters	Jun–Aug	None – No suitable habitat present
Silene scouleri subsp. *scouleri* Scouler's catchfly	–/–/2B.2	Coastal bluff scrub, coastal prairie, and valley and foothill grassland; 0–600 meters	(Mar–May) Jun–Aug (Sep)	Low – Not observed in general area since 1937 [Calflora].
Spergularia canadensis var. *occidentalis* Western sand-spurrey	–/–/2B.1	Coastal salt marshes; 0–3 meters	Jun–Aug	None – No suitable habitat present
Viola palustris Alpine marsh violet	–/–/2B.2	Swampy, shrubby places in coastal scrub or coastal bogs; 0–150 meters	Mar–Aug	None – No suitable habitat present
Fissidens pauperculus Minute pocket moss	–/–/1B.2	Damp soil along the coast, In dry streambeds and on streambanks, in North Coast coniferous forest; 10–1,024 meters	N/A	None – No suitable habitat present
Trichodon cylindricus Cylindrical trichodon	–/–/2B.2	Openings on sandy or clay soils on roadsides, stream banks, trails or in fields in broadleafed upland forest, and upper montane coniferous forest; 50–2,002 meters	N/A	None – No suitable habitat present

Table C1-2. Continued

Scientific Name Common Name	Legal Status[a] Fed/State/ CRPR	Habitat Requirements	Blooming Period	Potential for Occurrence and Rationale
Bryoria spiralifera Twisted horsehair lichen	–/–/1B.1	North Coast coniferous forest on the immediate coast, usually on conifers; 0–30 meters	N/A	Low – No suitable habitat present

Sources: Baldwin et al. 2012; CDFW 2018a, 2020a, 2020b; CNPS 2020; USFWS 2020a, 2020b

Notes:

[a] Legal Status explanations:

Federal

E = listed as Endangered under the federal Endangered Species Act

– = no listing under the federal Endangered Species Act

State

E = listed as endangered under the California Endangered Species Act

R = listed as rare under the California Native Plant Protection Act. This category is no longer used for newly listed plants, but some plants previously listed as rare retain this designation.

– = no listing

California Rare Plant Rank (CRPR)

1B = rare, threatened, or endangered in California and elsewhere

2B = rare, threatened, or endangered in California but more common elsewhere

3 = adequate information not available to determine ranking

.1 = seriously endangered in California

.2 = fairly endangered in California

.3 = not very endangered in California

Table C1-3. Plant Species Observed in the Terrestrial Biological Study Area

Family	Scientific Name	Common Name
Ferns		
Dennstaedtiaceae	*Pteridium aquilinum* var. *pubescens*	Western brackenfern
Equisetaceae	*Equisetum arvense*	Common horsetail
Polypodiaceae	*Polypodium scouleri*	Leather fern
Pteridaceae	*Polystichum munitum*	Sword fern
Gymnosperms		
Cupressaceae	*Hesperocyparis macrocarpa*	Monterey cypress
Pinaceae	*Pinus contorta* subsp. *contorta*	Shore pine
Monocots		
Allicaceae	*Allium triquetrum*	White flowered onion
Cyperaceae	*Carex obnupta*	Slough sedge
Juncaceae	*Juncus bufonius* var. *bufonius*	Toad rush
	Juncus effusus	Common bog rush
	Juncus lescurii	Dune rush
Eudicots		
Aizoaceae	*Carpobrotus aequilaterus*	Sea-fig
	Carpobrotus edulis	Hottentot-fig
Amaranthaceae	*Chenopodium* sp.	Lamb's quarters
Apiaceae	*Foeniculum vulgare*	Sweet fennel
Asteraceae	*Achillea millefolium*	Common yarrow
	Artemisia pycnocephala	Coastal sagewort
	Ambrosia chamissonis	Beach bur
	Anaphalis margaritacea	Pearly everlasting
	Baccharis pilularis subsp. *consanguinea*	Baccharis
	Erigeron glaucus	Seaside daisy
	Hesperevax sparsiflora var. *brevifolia*	Short leaved evax
	Layia carnosa	Beach layia
	Hypochaeris glabra	Smooth cats ear
	Tanacetum bipinnatum	Dune tansy
	Solidago spathulata	Coast goldenrod
Apiaceae	*Daucus pusillus*	Wild carrot
	Conium maculatum	Poison hemlock
Boraginaceae	*Cryptantha leiocarpa*	Coast popcorn flower
	Plagiobothrys reticulatus	Reticulate popcorn flower
Brassicaceae	*Brassica rapa*	Common mustard
	Raphanus raphanistrum	Wild radish
Caprifoliaceae	*Lonicera involucrata*	Twinberry
Caryophyllaceae	*Cakile maritima*	Sea rocket
	Cardionema ramosissima	Sand mat
	Daucus carota	Wild carrot

Table C1-3. Continued

Family	Scientific Name	Common Name
	Silene gallica	Common catchfly
	Spergularia rubra	Ruby sandspurry
Convolvulaceae	*Calystegia soldanella*	Beach morning glory
Dipsacaceae	*Dipsacus sativus*	Teasel
Fabaceae	*Acmispon americanus*	American bird's foot trefoil
	Acmispon micranthus	Hill lotus
	Lupinus arboreus var. *arboreus*	Coastal bush lupine
	Lupinus bicolor	Lupine
	Lupinus littoralis	Seashore lupine
	Medicago polymorpha	Bur clover
	Trifolium dubium	Shamrock
	Trifolium microcephalum	Small head clover
	Trifolium pratense	Red clover
	Trifolium subterraneum	Subterranean clover
	Vicia americana	American vetch
	Vicia hirsuta	Hairy vetch
	Vicia villosa subsp. *villosa*	Hairy vetch
Geraniaceae	*Erodium cicutarium*	Red-stemmed filaree
	Gernaium dissectum	Cut-leaved geranium
Montiacaceae	*Claytonia perfoliata*	Miner's lettuce
Myricaceae	*Myrica californica*	California wax myrtle
Myrsinaceae	*Lysimachia arvensis*	Scarlet pimpernel
Nyctaginaceae	*Abronia latifolia*	Coastal sand-verbena
Onagraceae	*Camissoniopsis cheiranthifolia* subsp. *cheiranthifolia*	Beach evening-primrose
	Camissonia strigulosa	Contorted sun-cups
	Clarkia davyi	Davy's clarkia
Orobanchaceae	*Parentucellia viscosa*	Yellow parentucellia
Papaveraceae	*Platystemon californicus*	Cream cups
Poaceae	*Aira praecox*	Little hair grass
	Alopecurus pratensis	Meadow foxtail
	Ammophila arenaria	European beach grass
	Anthoxanthum odoratum	Sweet vernal grass
	Avena fatua	Wild oat
	Briza maxima	Rattlesnake grass
	Briza minor	Small quaking grass
	Bromus diandrus	Ripgut brome
	Bromus hordeaceus	Soft chess
	Cortaderia selloana subsp. *selloana*	Pampas grass
	Deschampsia caespitosa	Tufted hair grass
	Festuca arundinacea	Reed fescue

Table C1-3. Continued

Family	Scientific Name	Common Name
	Festuca perennis	Perennial rye grass
	Festuca bromoides	Brome fescue
	Holcus lanatus	Velvet grass
Polemoniaceae	*Gilia millefoliata*	Dark-eyed gilia
Plantaginaceae	*Plantago erecta*	California plantain
	Plantago lanceolata	Ribwort
Plumbaginaceae	*Armeria maritima* subsp*. californica*	Sea pink
Polygonaceae	*Eriogonum latifolium*	Coast buckwheat
	Polygonum paronychia	Dune knotweed
	Rumex acetosella subsp*. acetosella*	Sheep sorrel
	Rumex salicifolius var. *crassus*	Willow leaved dock
Rosaceae	*Fragaria chiloensis*	Beach strawberry
	Rubus armeniacus	Himalayan blackberry
	Rubus ursinus	California blackberry
	Spiraea douglasii subsp. *douglasii*	Douglas spiraea
Rubiaceae	*Galium aparine*	Cleavers
Salicaceae	*Salix hookeriana*	Hookers willow
	Salix lasiolepis	Arroyo willow
Scrophulariaceae	*Nuttallanthus canadensis*	Canada toadflax
	Scrophularia californica subsp*. californica*	Bee plant
Valerianaceae	*Plectritis congesta*	Sea blush

Table C1-4. Special-Status Marine Species and Their Potential to Occur in the Marine Biological Study Area (MSA)

Common Name	Scientific Name	Listing Status	Habitat, *Critical Habitat*	Regional Occurrence	Potential to Occur in the MSA
Marine Mammals					
Baird's beaked whale	*Berardius bairdii*	P	Inhabit deep offshore waters in the North Pacific and are common along steep underwater geologic structures (e.g., submarine canyons, seamounts, and continental slopes).	Seasonal-sightings from late spring to early fall in California Very Rare	Not Expected. Sightings occur in deeper waters than the MSA, mainly along continental shelf edges or in deep submarine canyons where they forage. National Marine Fisheries records indicate less than a dozen individuals have been washed up along the west coast of the US.
Blainville's beaked whale	*Mesoplodon densirostris*	P	Found mainly over the continental shelf and into open ocean waters. Occupy tropical to temperate waters worldwide. Groups have been regularly observed off Oahu, Hawaii and in the Bahamas in 500- to 1,000-meter (m) waters.	Rare	Not Expected. Unlikely to be observed in the MSA.
Blue whale	*Balaenoptera musculus*	FE, FD, P	Found worldwide but often occur near the edges of physical features where krill tend to concentrate. These whales begin to migrate south during November.	Seasonal from June through November in California Common	Moderate to High. Relatively common offshore the California coast, in waters 90-370 kilometers (km) from shore.

Common Name	Scientific Name	Listing Status	Habitat, *Critical Habitat*	Regional Occurrence	Potential to Occur in the MSA
Bottlenose dolphin	*Tursiops truncatus*	P	Found in temperate and tropical waters around the world. Have both coastal and offshore populations. Common in areas where rivers meet the sea, and can be seen in harbors, bays and estuaries as well as far away from the shore.	Year-round Uncommon	Not Likely. Since 2010, bottlenose dolphins have been reoccurring as far north as San Francisco. It is possible they could occur in the MSA during times when waters are warmer than usual but historically, they do not occur north of central California.
Bryde's whale	*Balaenoptera edeni*	P	Found in highly productive tropical, subtropical, and warm temperate waters worldwide. More commonly found farther from shore.	Rare	Not Expected. Unlikely to be observed in the MSA.
California sea lion	*Zalophus californianus*	P	Reside in the Eastern North Pacific Ocean in coastal waters. Commonly observed along the west coast of North America from southeast Alaska to the central coast of Mexico.	Seasonal Common	High. Commonly observed
Common dolphin – long-beaked	*Delphinus capensis*	P	Found abundantly from Baja California northward to central California. Found in shallow, warmer temperate waters typically within 15 nautical miles (nm) of the coast and on the continental shelf.	Year-round Rare	Not Expected. The maximum northward extent is Point Arena, but numbers drop dramatically northward of central California.

Common Name	Scientific Name	Listing Status	Habitat, *Critical Habitat*	Regional Occurrence	Potential to Occur in the MSA
Common dolphin – short-beaked	*Delphinus delphis*	P	A more pelagic species than the long-beaked common dolphin, these dolphins are associated with the California Current and can be found up to 300 nm from shore. They are commonly found near underwater geologic features where upwelling occurs.	Year-round Common	Moderate. Generally found offshore of the MSA.
Cuvier's beaked whale	*Ziphius cavirostris*	P	Found in temperate, tropical, and subtropical waters. Associated in deep pelagic waters (usually greater than 1,000 m deep) of the continental shelf and slope, and near underwater geologic features. Seasonality and migration patterns are unknown.	Sightings in fall and winter in California Rare	Not Expected. Generally, occur in the deeper waters west of the MSA. One washed up on shore near the Mad River in March 1957 (Houck 1958).
Dall's porpoise	*Phocoenoides dalli*	P	Distributed throughout the North Pacific Ocean and along the west coast from the US border with Mexico to the Bering Sea. Mainly found in pelagic waters deeper than 180 m, but can be found both offshore and nearshore.	Sightings In winter and early spring in California Common	Low to moderate. Most frequently observed offshore but have been seen in nearshore oceanic waters.
Dwarf sperm whale	*Kogia simus*	P	Occur over the continental slope and open ocean. Live in tropical and temperate waters worldwide. Found in the Pacific Northwest and California, but more common near Hawaii and the Gulf of Mexico.	Rare	Not Expected. Not likely to be observed within the MSA. Records of dwarf sperm whales are rare and it is unknown whether low numbers are a consequence of their cryptic behavior or if they are not regular inhabitants of offshore California waters.

Common Name	Scientific Name	Listing Status	Habitat, *Critical Habitat*	Regional Occurrence	Potential to Occur in the MSA
False killer whale	*Pseudorca crassidens*	P	Occur over the continental slope and into open ocean waters with depths over 3,000 feet of tropical and warm temperate waters worldwide.	Sightings in summer and early fall in California Rare	Not Expected. Not likely to occur in the MSA because they prefer warmer waters than within the MSA.
Fin whale	*Balaenoptera physalus*	FE, FD, P	Occupy the deep, offshore waters of all major oceans but primarily are in temperature to polar waters.	Seasonal in California Common	Moderate. Relatively common in California waters between March and October, but due to their occurrence farther offshore in deep water, it is not likely they would be seen in the MSA in high numbers.
Ginkgo-toothed whale	*Mesoplodon ginkgodens*	P	Found mainly over the continental shelf and into open ocean warm waters of the Pacific and Indian Oceans.	Rare	Not Expected. No documented sightings in the MSA.
Gray whale (Western North Pacific)	*Eschrichtus robustus*	FE, FD, P	Predominantly occur within the nearshore coastal waters of the North Pacific Ocean, from the Gulf of Alaska to the Baja Peninsula.	Seasonal December through May in California Common	Moderate-High. Occur in coastal waters during late fall-winter southward migration and again late-winter to early-summer during their northward migration. Can be as close as a few hundred yards of shore but more common 3-12 miles offshore.

Common Name	Scientific Name	Listing Status	Habitat, *Critical Habitat*	Regional Occurrence	Potential to Occur in the MSA
Guadalupe (Southern) fur seal	*Arctocephalus townsendi*	CT, FT, FD	Reside in tropical waters of Southern California and Mexico. Breed in rocky coastal habitats and caves mainly along the eastern coast of Guadalupe Island, approximately 200 km west of Baja California. There is a small population on San Miguel Island in the Channel Islands.	Very Rare	Not Expected. Unlikely to occur north of Point Conception in Southern California.
Harbor porpoise	*Phocoena phocoena*	P	Continental slope to oceanic waters, mainly in northern temperate, subarctic coastal, and offshore waters. Commonly found in bays, estuaries, harbors, and fjords less than 200 m deep. In California, most common north of Point Conception.	Year-round in California Uncommon	Moderate. Occasionally observed in Humboldt Bay and adjacent waters. Potential to occur in the MSA between 0- and 200-m depth.
Harbor seal	*Phoca vitulina*	P	Found as far north as British Columbia, Canada and as far south as Baja California, Mexico. Most commonly observed pinniped along California coastline. Use the offshore waters for foraging and beaches for resting. Occur on offshore rocks, on sand and mudflats in estuaries and bays, and on some isolated beaches.	Year-round in California Common	High. Common throughout the California coast. Harbor seals favor nearshore coastal waters. Abundant in Humboldt Bay.
Hubb's beaked whale	*Mesoplodon carlhubbsi*	P	Endemic to the North Pacific Ocean. Species is not well known but assumed to occur mainly over the continental shelf and into open ocean waters.	Very Rare	Not Expected. May occur in waters offshore of Central and Northern California, but the species is very rare.

Common Name	Scientific Name	Listing Status	Habitat, *Critical Habitat*	Regional Occurrence	Potential to Occur in the MSA
Humpback whale	*Megaptera novaeangeliae*	FE, FD, P	Found in all major oceans. The California population of humpback whales migrates from their winter calving and mating areas off Mexico to their summer and fall feeding areas off coastal California. Humpback whales occur from late April to early December.	Seasonal-May through November in California Common	High. Frequently observed migrating along the California coast between April and November, up to 90 km offshore.
Killer whale	*Orcinus orca*	FE, FD, P	Found throughout all oceans. Most abundant in colder waters but can be somewhat abundant in temperate water. Presence and occurrence can be common but unpredictable in coastal California.	Seasonal in California Uncommon	Low. Most common during April, May, and June as they feed on northbound migrating gray whales. Generally observed in the deeper offshore waters of the MSA.
Long-snouted spinner dolphin	*Stenella longirostris*	FD, P	Found in all tropical and subtropical oceans. Continental shelf to open ocean waters but most commonly in the deep ocean where they track prey.	Sightings in summer and early fall in California Rare	Not expected to occur in the MSA because they inhabit warmer waters than occur in the MSA.
Minke whale	*Balaenoptera acutorostrata*	P	Distributed worldwide and can be in coastal/inshore and over the continental shelf in temperate (preferred), boreal, or polar waters.	Year-round in California Uncommon	Not Expected-Low. Minke whale sightings have occurred throughout the California coast. While rare, they could be observed within the MSA.
North Pacific right whale	*Eubalaena japonica*	FE, FD, P	Found in the North Pacific Ocean. Seasonally migratory; inhabit colder waters for feeding, and then migrate to warmer waters for breeding and calving. Although they may move far out to sea during their feeding seasons, right whales give birth in coastal areas.	Rare	Not Expected. This species is the rarest of all large whale species, and fewer than 50 individuals are believed to occupy US waters.

Common Name	Scientific Name	Listing Status	Habitat, *Critical Habitat*	Regional Occurrence	Potential to Occur in the MSA
Northern elephant seal	*Mirounga angustirostris*	P	Found from Alaska to Mexico. They are sighted regularly over shelf, shelf-break, and slope habitats; and they also are present.in deep ocean habitats seaward of the 2,000-m isobaths. Rookeries are located in the Channel Islands, Año Nuevo State Park, near San Simeon in San Luis Obispo County, and in Point Reyes National Park.	Year-round in California Common	Moderate. Northern elephant seals are widely distributed along the west coast of North America but spend about 9 months of the year at sea.
Northern fur seal	*Callorhinus ursinus*	FD, P	Spend 300 or more days per year foraging in the open ocean of the North Pacific. Use rocky beaches for reproduction. Usually come ashore in California only when debilitated; however, a few individuals have been observed on Año Nuevo Island.	Year-round in California Common	Not Expected. Usually 18-28 km from California's shoreline.
Northern right whale dolphin	*Lissodelphis borealis*	P	Endemic to deep, cold temperate waters of the North Pacific Ocean. Also occur over the continental shelf and slope where waters are less than 66°F.	Year-round in California Common	Not Expected. Tend to occupy deep, cold waters near the continental shelf and seaward.
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	P	Occupy temperate waters of the North Pacific. Found from the continental shelf to the deep ocean.	Year-round in California Common	Low. Likely to occur throughout the California coastline but typically do not occur in nearshore waters.

Common Name	Scientific Name	Listing Status	Habitat, *Critical Habitat*	Regional Occurrence	Potential to Occur in the MSA
Perrin's beaked whale	*Mesoplodon perrini*	P	Believed to occupy continental shelves and open ocean waters of the Pacific but not well documented.	Very Rare	Not Expected. This whale is known from less than half a dozen strandings between San Diego and Monterey. It is highly unlikely that it will be observed within the MSA, but the species' complete distribution is unknown.
Pygmy sperm whale	*Kogia breviceps*	P	Occur over the continental slope and open ocean. Prefer tropical, subtropical, and temperate waters of the Pacific Ocean. They are mostly found offshore of Peru but also occur in the waters near Hawaii and the Pacific Northwest.	Rare	Not Expected. Unlikely to occur in the nearshore waters of the MSA. Strandings have been documented off Mexico, New Zealand, and Monterey Bay. Overall the species is rare and is expected to only occur south of the MSA.
Risso's dolphin	*Grampus griseus*	P	Distributed throughout all major oceans. Generally found in waters greater than 1,000 m in depth and seaward of the continental shelf and slopes.	Year-round in California Common	Low. They generally occur in the deeper offshore waters of the MSA.
Rough-toothed dolphin	*Steno bredanensis*	P	Found in all tropical and subtropical oceans. Continental shelf to open ocean waters. Prefer the depths of tropical and warmer temperate waters.	Sighting in summer and early fall in California Rare	Not Expected. Unlikely to occur in the relatively cold waters of the MSA.
Sei whale	*Balaenoptera borealis*	FE, FD, P	Wide distribution occurring in subtropical, temperate, and subpolar waters around the world. Usually observed in deeper waters of oceanic areas far from the coastline.	Seasonal-spring and summer in California Common	Not Expected. Sei whales primarily occupy the open ocean, far away from shore.

Common Name	Scientific Name	Listing Status	Habitat, *Critical Habitat*	Regional Occurrence	Potential to Occur in the MSA
Short-finned pilot whale	*Globicephala macrorhynchus*	P	Found in warmer tropical and temperate waters. Commonly seen along the coast close to the continental shelf. Forage in areas with high densities of squid.	Year-round in California Very Rare	Not Expected. Generally found in deeper, warmer water than that which occurs in the MSA.
Southern sea otter	*Enhydra lutris nereis*	FT, P, P	A top carnivore in its coastal range and a keystone species of the nearshore coastal zone. Frequent inhabitor in kelp forests.	Year-round in Central and Southern California Common	Not Expected. Southern sea otters occupy the nearshore waters of California from San Mateo County south to Santa Barbara County. They are unlikely to be observed as far north as Eureka in Northern California.
Sperm whale	*Physeter macrocephalus*	FE, FD, P	Occur globally in the open ocean far from land and are uncommon in waters less than 300 m deep. Live at the surface of the ocean but dive deeply to catch giant squid.	Seasonal-late spring and late fall in California Common	Not Expected. Sperm whales are present offshore California year-round. They peak in abundance in late spring and late summer but are rarely seen because they occupy deep offshore water.
Spotted dolphin	*Stenella attenuata*	FD, P	Typically found far away from the coast in tropical and subtropical waters worldwide but also can occupy waters over the continental shelf. Spend majority of day in waters 90-300 m deep and then dive to depth at night to search for prey.	Sightings in summer and early fall in California Rare	Not Expected. The eastern Pacific Ocean population typically is observed far from the coast, and the population has been depleted.
Stejneger's beaked whale	*Mesoplodon stejnegeri*	P	Found in cold, temperate, and subarctic waters of the North Pacific Ocean. Typically occupy deep offshore waters.	Rare	Not Expected. Typically found in deep, offshore waters on or beyond the continental shelf.

Common Name	Scientific Name	Listing Status	Habitat, *Critical Habitat*	Regional Occurrence	Potential to Occur in the MSA
Steller (Northern) sea lion	*Eumetopias jubatus*	FE, FD, P	Distributed around the coasts along the North Pacific Ocean rim. Common in coastal waters and onshore for resting. ***Critical Habitat:*** *A zone that extends approximately 1,000 m seaward and landward of any Steller sea lion rookery in Washington, Oregon, and California. Any aquatic foraging habitat within the species geographic range.*	Seasonal in California Common	Moderate. Documented as relatively common along northern California's coast.
Striped dolphin	*Stenella coeruleoalba*	P	Continental shelf to open ocean waters worldwide, often found in areas of upwelling and around convergence zones. Prefer highly productive tropical to warm temperate waters that are oceanic and deep.	Sightings in summer and early fall in California Rare	Not Expected. Unlikely to occur near the MSA. Observations are typically far offshore.
Marine Turtles					
Green sea turtle	*Chelonia mydas*	FE, P	Distributed globally. Primarily use three types of habitat: oceanic beaches (for nesting), convergence zones in the open ocean, and benthic feeding grounds in coastal areas. ***Critical Habitat:*** *waters surrounding Puerto Rico.*	Seasonal in California Rare	Not Expected. In the eastern Pacific, green turtles have been sighted from Baja California to southern Alaska but most commonly occur from San Diego south. Northernmost sighting is offshore Marin County.

Common Name	Scientific Name	Listing Status	Habitat, *Critical Habitat*	Regional Occurrence	Potential to Occur in the MSA
Leatherback sea turtle	*Dermochelys coriacea*	FE, P	Distributed globally. Regularly seen off the western coast of the US in the pelagic, with the greatest densities found off central California.	Seasonal in California Occasional	Not Expected. Leatherback sea turtles are most commonly seen between July and October, when the surface water temperature warms to 15-16° C and large jellyfish, the primary prey of the turtles, are abundant offshore. Northernmost sighting is offshore Marin County.
Olive ridley sea turtle	*Lepidochelys olivacea*	FT, P	Mainly a "pelagic" sea turtle in tropical/temperate regions of the Pacific, South Atlantic, and Indian Oceans but has been known to inhabit coastal areas, including bays and estuaries.	Seasonal in California Very Rare	Not Expected. In the Eastern Pacific, the reported range of the Olive ridley turtle extends from southern California to northern Chile. In warmer El Niño years, they may be observed offshore Northern California (as in 2002 in Mendocino and Humboldt Counties).
Loggerhead sea turtle	*Caretta caretta*	FE, P	Distributed throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. Occupy three different ecosystems during their lives: the terrestrial zone, the oceanic zone, and the neritic or nearshore coastal area. ***Critical Habitat:*** *The Northwest Atlantic Distinct Population Segment (DPS) critical habitat includes waters throughout the Gulf of Mexico around the Florida panhandle and up the eastern seaboard of the US.*	Seasonal in California Common	Not Expected. In the Eastern Pacific, most recorded sightings are restricted to Southern California. However, sightings are also reported as far north as Oregon and Washington. No. known sightings in Northern California have been reported.

Common Name	Scientific Name	Listing Status	Habitat, *Critical Habitat*	Regional Occurrence	Potential to Occur in the MSA
Sharks and Bony Fishes					
Basking shark	*Cetorhinus maximus*	CSC, P	This species movements and migrations are poorly understood. Usually sighted from British Columbia to Baja California in winter and spring; their destination, once they leave coastal areas, is unknown.	Seasonal in California Very Rare	Not Expected. Basking shark populations were severely depleted by commercial fisheries in the 1950s, and they have never fully recovered due to slow growth and low fecundity.
Bluefin tuna	*Thunnus thynnus*	FSC	A highly migratory species, bluefin tuna are distributed throughout the North Pacific. These tunas are pelagic and found in temperate and tropical oceans. They also can be found in coastal regions. They are typically in the upper 200 m.	Year-round in California Common	Moderate-High. Likely to be present offshore of Northern California.
Bocaccio	*Sebastes paucispinis*	FE	A species of coastal rockfish found in the Pacific, from Baja California northward to the Gulf of Alaska. Most are caught in water between 75 and 230 m.	Year-round in California Common	Low-Moderate. Most abundant between Oregon and Baja California, but species is struggling to recover from overfishing.
Canary rockfish	*Sebastes pinniger*	FSC	A coastal rockfish found between Baja California and the Western Gulf of Alaska. Most common off the Oregon central coast. Tend to occupy water depths around 150 m but can be found as deep as 275 m.	Year-round in California Common	Low-Moderate. The species was declared overfished in 2000 and was rebuilt in 2015. Juveniles tend to stay near the water surface, and adults move to deeper benthic habitats.

Common Name	Scientific Name	Listing Status	Habitat, *Critical Habitat*	Regional Occurrence	Potential to Occur in the MSA
Chinook salmon (California Coastal Evolutionary Significant Unit)	*Oncorhynchus tshawytscha*	CE, FE, P	Live in freshwater streams up to the first two years of life, then they migrate to estuarine areas as smolts and eventually the ocean to mature and feed. These salmon prefer deeper and larger streams than those used by other Pacific species. ***Critical Habitat:*** *All major rivers and coastal stretches of rivers and creeks in Sonoma, Mendocino, and Humboldt counties in California. Includes all ocean water and substrate to the full extent of the Economic Exclusion Zone.*	Seasonal in California Common.	High. Present in coastal waters and larger streams and rivers throughout northern California.
Chinook salmon – Spring run (Klamath-Trinity Rivers population)	*Oncorhynchus tshawytscha*	FE	Upper Klamath-Trinity Rivers and coastal waters in northern California. ***Critical Habitat:*** *All major rivers and coastal stretches of rivers and creeks in Humboldt, Del Norte, Trinity, and Northern California counties. Includes all ocean water and substrate to the full extent of the Economic Exclusion Zone.*	Seasonal in California Common	High. This population is endemic to the Klamath-Trinity Rivers.
Chum salmon	*Oncorhynchus keta*	CE	Chum salmon are the most widely distributed of all the salmon species found in the Pacific. They inhabit waters throughout the North Pacific Ocean to the coastal regions of North American and Asia.	Common	Low. The status of Chum salmon in California is poorly understood, and it is believed that their numbers are too small to be detected.

Common Name	Scientific Name	Listing Status	Habitat, *Critical Habitat*	Regional Occurrence	Potential to Occur in the MSA
Cowcod	*Sebastes levis*	CSC, FCS, P	Found from central Oregon to Baja California, Mexico. Juveniles recruit to fine sediment habitat. They have been observed at depths between 40 and 100 m. Young cowcod move to deeper habitat within their first year.	Seasonal in California Common	Moderate. Documented catch has declined drastically since the mid 1980s. May be present near the seafloor.
Coho salmon (Northern California population)	*Oncorhynchus kisutch*	FE, CE, P	Spawn in small streams with gravel substrates and spend first half of life cycle in streams and small freshwater tributaries. The later-half of life cycle is spent foraging in estuarine and marine waters.	Seasonal in California Common	High. Coho salmon inhabit Big Lagoon, just north of Eureka.
Longfin smelt	*Spirinchus thaleichthys*	CT	Found along the Pacific Coast from Alaska to California. Adults live primarily in bays, estuaries, and nearshore coastal areas, migrating to low salinity or freshwater reaches to spawn. Spawning occurs primarily in January to March.	Seasonal in California Common	Moderate. Humboldt Bay ranks second in longfin smelt abundance after the Sacramento-San Joaquin Delta/San Francisco Bay Estuary. Seasonally absent from marine waters as spawning occurs in freshwater, typically from January to March.
North American green sturgeon (Northern DPS)	*Acipenser medirostris*	CSC, FSC	The Northern DPS of green sturgeon are those that spawn from the Eel River northward to the Klamath and Rogue Rivers. ***Critical Habitat:*** *All ocean water out to 60 fathoms depth from Monterey Bay northward to the border with Canada.*	Common	Low. There are very few data on the presence of green sturgeon in coastal waters. This species may forage in or near the MSA, but its distribution in ocean waters is essentially unknown.

Common Name	Scientific Name	Listing Status	Habitat, *Critical Habitat*	Regional Occurrence	Potential to Occur in the MSA
Pacific Ocean perch	*Sebastes alutus*	FSC	Distributed from the Western Aleutian Islands in Alaska to throughout California, although they become increasingly rare moving south through California.	Common	Low-Moderate. Adults and juveniles appear to inhabit water depths ranging between 150 and 420 m.
Pink salmon	*Oncorhynchus gorbuscha*	CE	Distributed on both sides of the North Pacific Ocean and the most abundant of the Pacific salmon. Common from Alaska through Washington but also known to occur in Northern California. Spawn in freshwater streams and rivers but do not spend extended periods of time in fresh water. Instead they migrate out to the ocean to feed and grow.	Common	Low. More common in Washington and Alaska.
Steelhead trout (Northern California DPS)	*Onchorhynchus mykiss irideus*	FT, CSC, P	Can be found along the entire Pacific Coast of Northern California. Anadromous individuals can spend up to 7 years in fresh water prior to smoltification and then spend up to 3 years in saltwater prior to first spawning. Individuals that spend their entire life in freshwater are called rainbow trout. ***Critical Habitat:*** *Essentially all major rivers and coastal stretches of all rivers and creeks throughout California.*	Seasonal in California Common	Moderate. Spawn in streams and rivers throughout Northern California. Adults may occur in coastal waters near streams and rivers.

Common Name	Scientific Name	Listing Status	Habitat, *Critical Habitat*	Regional Occurrence	Potential to Occur in the MSA
Steelhead trout (Klamath Mountains)	*Onchorhynchus mykiss irideus*	FSC, P	Same as the Northern California DPS but endemic to the rivers associated with the Klamath Mountains.	Year round Common	Moderate. Spawn in streams and rivers of the Klamath Mountains. Adults may occur in the coast waters associated with these freshwater systems.
Swordfish	*Xiphias gladius*	FSC	Distributed throughout the world's oceans, mostly in tropical and temperate waters, but they have been documented in cold waters of major oceans. They are found along the eastern edge of the North Pacific Ocean.	Common	Low. Swordfish are mostly found in offshore waters and farther south than the MSA.
Tidewater goby	*Eucycloglobius newberryi*	CSC, FE, P	Despite the common name, this goby inhabits lagoons formed by streams running into the sea. Because the lagoons are blocked from the Pacific Ocean by sandbars, admitting salt water only during particular seasons, their water is brackish and cool. The tidewater goby prefers salinities of less than 10 parts per thousand (less than a third of the salinity found in the ocean) and thus is more often found in the upper parts of the lagoons, near their inflow. ***Critical Habitat:*** *The Big Lagoon in Humboldt County is designated as critical habitat for the tidewater goby.*	Seasonal in California Common	Not Expected. Although Big Lagoon is recognized as critical habitat for the tidewater Goby, the species spends its entire life within estuaries and tidal lagoons. Not expected to be present.in the MSA.

Common Name	Scientific Name	Listing Status	Habitat, *Critical Habitat*	Regional Occurrence	Potential to Occur in the MSA
White shark	*Carcharodon carcharias*	CSC, P	Coastal and offshore waters along the continental shelf and islands. In California, important white shark habitat occurs around Monterey Bay and Greater Farallon's National Marine Sanctuaries. White shark populations are affected by purposeful and incidental capture by fisheries, marine pollution, and coastal habitat degradation.	Year-round in California Common	High. Present in coastal waters throughout California.
Widow rockfish	*Sebastes entomelas*	FSC	A coastal rockfish found between the north end of Baja California and the Gulf of Alaska. Most common between British Columbia and Northern California. Most commonly found between approximately 130 and 230 m depth	Year-round in California Common	Low. Not regularly seen in California. Adults of the same size class tend to move seasonally between adjacent areas.
Yelloweye rockfish	*Sebastes ruberrimus*	FSC	Distributed throughout Alaska and the West Coast of the US. Primarily inhabit high-relief rocky habitats in depths ranging between approximately 20 and 375 m.	Year-round in California Common	Low. Rebuilding of their numbers from overfishing requires decades.

Common Name	Scientific Name	Listing Status	Habitat, *Critical Habitat*	Regional Occurrence	Potential to Occur in the MSA
Gastropods					
Black abalone	*Haliotis cracherodii*	FE, P	Found in coastal and offshore island intertidal habitats on exposed rocky shores where bedrock provides deep, protective crevices for shelter. Range from Point Arena, California to Bahia Tortugas and Isla Guadalupe, Mexico. Very rare in Northern California. ***Critical Habitat:*** *Essentially all of the California coast.*	Year-round in California Very Rare	Not Expected. They are rare north of San Francisco, and Point Arena is considered the northward-most extent of the species.
Green abalone	*Haliotis fulgens*	FSC, P	Coastal and offshore island intertidal habitats on exposed rocky shores where bedrock provides deep, protective crevices for shelter. Green abalone habitat ranges from Point Conception, California to Bahia Magdalena, Baja California Sur, Mexico.	Year-round in California Very Rare	Not Expected. Green abalone are not likely to occur north of Point Conception, California.
Pink abalone	*Haliotis corrugate*	FSC, P	Coastal and offshore island intertidal habitats on exposed rocky shores where bedrock provides deep, protective crevices for shelter. Distributed from Point Conception to Bahia de Santa Maria in Baja California, Mexico.	Year-round in California Very Rare	Not Expected. Pink abalone are unlikely to be found north of the Southern California Bight.

Common Name	Scientific Name	Listing Status	Habitat, *Critical Habitat*	Regional Occurrence	Potential to Occur in the MSA
White abalone	*Haliotis sorenseni*	FE, P	Coastal and offshore island intertidal habitats on exposed rocky shores where bedrock provides deep, protective crevices for shelter. Range from Point Conception, California to Punta Abreojos, Baja California, Mexico.	Year-round in California Very Rare	Not Expected. White abalone are not likely to occur north of Point Conception, California.

Sources: Allen 2014; Allen et al. 2010; AMS 2015; CDFW 2009, 2012, 2018b; Dick et al. 2009; Driscoll 2014; Houck 1958; Kimmey 2015; Love and Yoklavich 2008; Marine Mammal Commission 2018; Miller and Shanks 2004; NOAA 2011, 2014, 2018, 2019a, 2019b, 2019c, 2019d, 2019e, 2020; Prado 2016; Whaleopedia 2019

Terms:

FESA = federal Endangered Species Act

MMPA = Marine Mammal Protection Act

CESA = California Endangered Species Act

Notes:

Status Codes:

Federal: National Oceanographic and Atmospheric Administration (NOAA); MMPA

FD = Depleted Population

P = Federally Protected

Federal: U.S. Fish and Wildlife Service (USFWS), NOAA National Marine Fisheries Service (NMFS); FESA

FDL = Delisted

FE = Listed as “endangered” (in danger of extinction) under FESA

FT = Listed as “threatened” (likely to become Endangered within the foreseeable future) under FESA

FC = Candidate to become a proposed species

FSC = Former “federal species of concern.” The USFWS no longer lists Species of Concern but recommends that species considered to be at potential risk by a number of organizations and agencies be addressed during project environmental review. *NMFS still lists “Species of Concern.”

State: California Department of Fish and Game (CDFG); CESA

CE = Listed as “endangered” under the CESA

CT = Listed as “threatened” under the CESA

CSC = CDFW designated “species of special concern”

Potential for Species Occurrence Rankings

Not Expected – Suitable foraging or spawning habitat is not known to be present or rare, and the species has not been or has been rarely documented to occur.

Low – Suitable foraging or spawning habitat is present, but the species has either not been documented to be present or if present, the presence is uncommon and infrequent.

Moderate – Suitable foraging or spawning habitat is present, and the species is somewhat common or common for part of the year.

High – Suitable foraging or spawning habitat is present, and the species is common throughout the year and/or in substantial numbers.

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APPENDIX C2 MARINE BIOLOGICAL RESOURCES REPORT

Marine Aquatic Habitats and Biological Resources Offshore Eureka, California

August 2019

Revised: October 2020

Prepared for:

RTI

Prepared by:

APPLIED marine SCIENCES

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1 Introduction

The purpose of this review is to present a broad scientific overview of the marine habitats and associated biota occurring in the intertidal, subtidal, and pelagic regions present offshore coastal Northern California. This review is based on scientific literature and field studies conducted near the RTI Eureka Subsea Cables Marine Study Area or in nearshore waters of California, where applicable. For the purposes of this review, the analysis of seafloor habitats and associated marine taxa covers the water depth range of 0 – 184 m (0 – 600 ft). For fishes and marine mammals, the analysis extends out to 1,800 meters (m) (5,904 feet [ft]) water depth.

Figure 1 provides an illustration of the Marine Study Area offshore Humboldt Bay and Eureka, California, a graphical presentation of coastal bathymetry and topography, as well as areas of special concern or marine protection.

2 Pertinent Scientific Surveys of Marine Habitats in Northern California and Southern Oregon

Recent scientific investigations of intertidal, subtidal, and pelagic habitats and associated marine biota conducted in Northern California and Southern Oregon that have been used to prepare this document include:

- Areas of special biological significance, California's marine state water quality protection areas (SWRCB 2003);
- Patterns of Benthic Macroinvertebrate Communities and Habitat Associations in Temperate Continental Shelf Waters of the Pacific Northwest (Lee 2012);
- Benthic habitat characterization offshore the Pacific Northwest Volume 1: Evaluation of continental shelf geology (Goldfinger *et al.* 2014);
- Benthic habitat characterization offshore the Pacific Northwest Volume 2: Evaluation of continental shelf benthic ecology (Henkel *et al.* 2014);
- North Central California coast marine protected areas baseline characterization and monitoring of mid-depth rock and soft-bottom ecosystems (20–116 m) (Lindholm *et al.* 2014);
- Baseline monitoring of rocky reef and kelp forest habitat of the North Coast region (Jenkins and Craig 2017);
- Humboldt open ocean disposal site (HOODS) 2008 and 2014 monitoring synthesis report (EPA 2016);
- North coast baseline program final report, mid-depth, and deep subtidal ecosystems (Lauermann *et al.* 2017);

- Baseline characterization of sandy beach ecosystems along the north coast of California (Nielsen *et al.* 2017);
- Invertebrate and fish observation listings from remotely-operated vehicle (ROV) surveys of the Point Arena and 10-mile Marine Protected Areas and near the Noyo River (MARE 2017); and
- Mapping marine habitat suitability and uncertainty of Bayesian networks: A case study using Pacific benthic macrofauna (Havron *et al.* 2017).

In addition to the above-listed surveys conducted specifically in Northern California and Southern Oregon, habitat and marine biota assessments for other cable landings in California provide valuable insights into the ecosystem relationships and distribution of invertebrate and vertebrate taxa. These scientific surveys include:

- MCI/WorldCom fiber optic cable project, Montana del Oro/Morro Bay (SAIC-SLO 1999);
- AT&T US/China fiber optic cable project, Morro Bay and Point Arena (SAIC 1999);
- Pacific crossing and Pan American crossing fiber optic cable landing, Grover Beach (AMS 1999a);
- Tyco Global West fiber optic cable project, San Diego, Manhattan Beach, Santa Barbara, and Morro Bay (SAIC 2000);
- Tycom fiber optic cable project, Hermosa Beach (MBC 2001);
- Monterey Bay Aquarium Research Institute MARS fiber optic cable project, Monterey Bay (MBARI 2004);
- AT&T AAG S-5 fiber optic cable project, Montana del Oro/Morro Bay (AMS 2008); and
- SEA-US 1 fiber optic cable project, Hermosa Beach (AMS 2016a).

Finally, the effects of physical disturbance to subtidal hard substrate habitats and associated marine biota, and the recovery of those marine communities following direct and indirect disturbance, have been extensively studied in conjunction with offshore oil and gas exploration and production operations in the Pacific Outer Continental Shelf and for previously installed coastal fiber optic and electric transmission cables. The results of these scientific investigations have been studied and discussed in:

- Recolonization of deep-water hard substrate communities: potential impacts from oil and gas development (Lissner *et al.* 1991);
- A survey of prominent anchor scars and the level of disturbance to hard-substrate communities in the Point Arguello region (Hardin *et al.* 1993);
- ATOC/Pioneer Seamount cable effects study (Kogan *et al.* 2006);

- MARS fiber optic cable impacts to the marine environment in Monterey Bay National Marine Sanctuary (Kuhnz *et al.* 2015);
- Installation and operational effects of a HDAC submarine cable in Australia (Sherwood *et al.* 2016);
- Submarine cables in Olympic Coast National Marine Sanctuary (Antrim *et al.* 2018); and
- Seabed recovery following protective burial of subsea cables (Kraus and Carter 2018).

3 Pelagic Open Water Habitat and Associated Biological Communities

The pelagic zone supports a number of planktonic organisms (phytoplankton, zooplankton, and ichthyoplankton) that float with the currents, as well as nektonic organisms, such as bony fishes, sharks, and marine mammals that move freely against local and oceanic currents.

3.1 Plankton

Phytoplankton, the primary producers at the base of the marine food web, are consumed by many species of zooplankton. In turn, zooplankton support a variety of species including small schooling fishes (e.g., sardines, herring) and baleen whales (Mysticeti). In the marine environment, phytoplankton tend to be nutrient limited, explaining why they are found at higher densities near coastlines where nutrient inputs from terrestrial point and non-point sources help promote their growth (Fischer 2014). The abundance and composition of phytoplankton along the west coast of California is influenced by the upwelling system and tends to be dominated by diatoms year-round (Du *et al.* 2016). Winds blowing from the north create a current running north to south along the shore that promotes upwelling as well as mixing of plankton over large spatial scales. Relaxation of upwelling and stratification of the water column promotes the growth of phytoplankton. Some phytoplankton taxa, such as dinoflagellates and various species of the *Pseudonitzschia* genus are considered harmful (Du *et al.* 2016).

Organisms that complete their entire life cycle as planktonic forms are called holoplankton and include phytoplankton and zooplankton. Holoplankton have short generation times (hours to weeks), reproduce continually (i.e. are not dependent on a certain season), and are not restricted to specific geographic zones. Plankton that only spend part of their life cycle as planktonic forms, such as eggs and larvae, are called meroplankton. Meroplankton make up a small fraction of the total number of planktonic organisms in seawater. They have shorter spawning seasons, are restricted to a narrow region of the coast, and are at greater risk of mortality from anthropogenic causes, such as subsea construction. As a result, investigations of harmful effects on marine biota in California typically assess effects on meroplanktonic species as proposed by the U.S. EPA (EPA 1977). Important meroplankton include larvae and eggs of commercially important fishes, lobsters, crabs, octopus and squid.

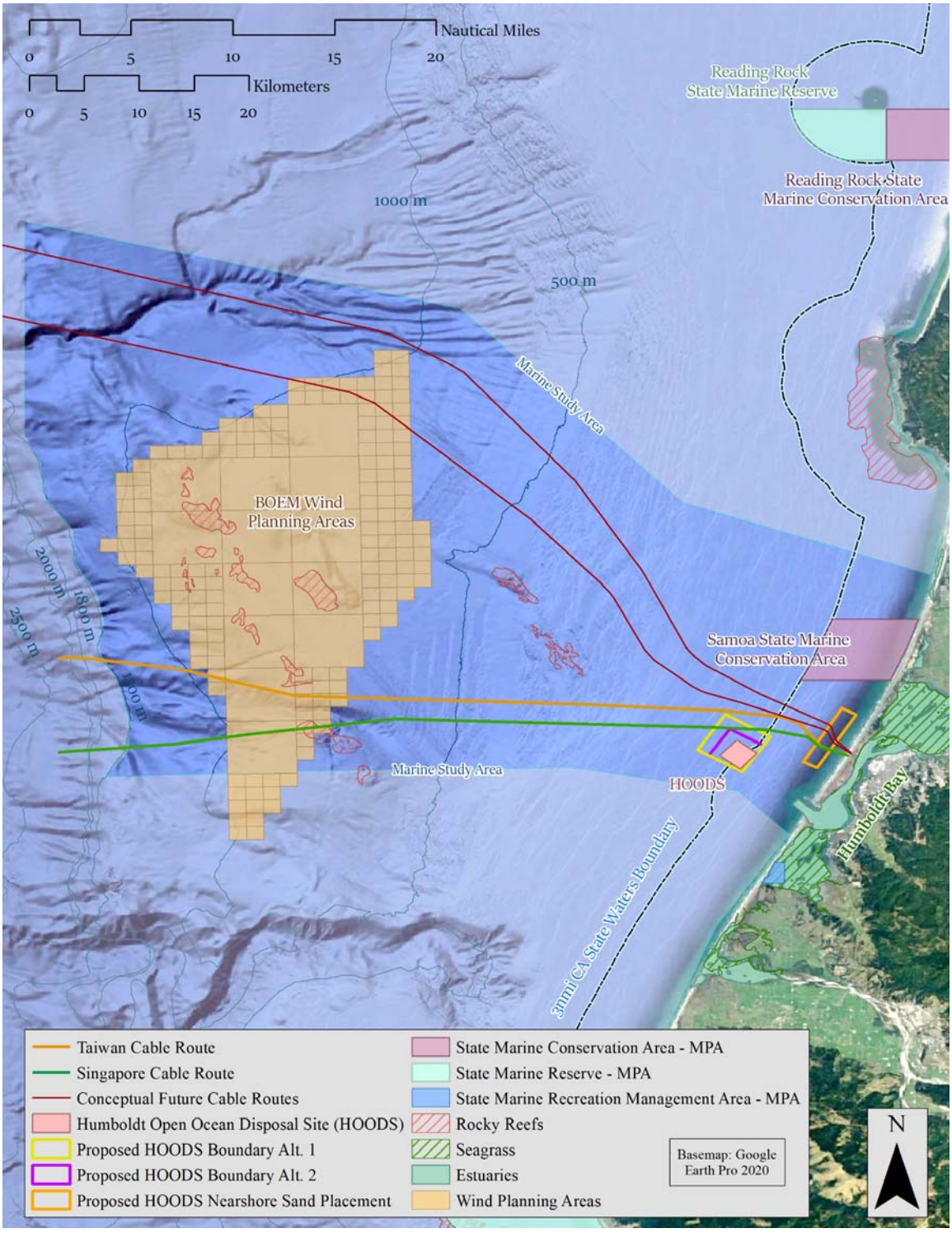

Figure 1: Marine Study Area for the RTI-Eureka Subsea Cables Project

3.2 Marine Mammals and Sea Turtles

3.2.1 Marine Mammals

All marine mammals are protected under the Marine Mammal Protection Act (MMPA), and some species are further protected under the Federal Endangered Species Act (FESA). Marine mammals have the same physiological characteristics as terrestrial mammals but are adapted to live in ocean waters for either all or part of their life. Some marine mammals have evolved a thick layer of fat that allows them to maintain their body temperature. All marine mammals must come to the surface to breathe, but some species can hold their breath and remain underwater for extended periods of time. This is achieved by slowing the heart rate during a dive to conserve oxygen. Marine mammals include whales, dolphins, porpoises, seals, sea lions, walruses, sea otters, manatees, dugongs, and the polar bear.

The entire California coast is home to an abundance of marine mammals. Several species are regular or periodic inhabitants of the waters offshore Eureka and Northern California, and many are commonly observed in nearshore in less than 200 meters of water. The California sea lion (*Zalophus californianus*), harbor seal (*Phoca vitulina*), and humpback whale (*megaptera novaeangeliae*) are highly likely to be observed in the waters of the Marine Study Area. Other marine mammals that are moderately likely to be observed within the Marine Study Area include blue whales (*Balaenoptera musculus*), common dolphins (*Delphinus delphis*), fin whales (*Balaenoptera physalus*), gray whales (*Eschrichtus robustus*), harbor porpoises (*Phocoena phocoena*), northern elephant seals (*Mirounga angustirostris*), and steller sea lions (*Eumetopias jubatus*). In addition, there is a low probability that Dall's porpoises (*Phocoenoides dalli*), killer whales (*Orcinus orca*), minke whales (*Balaenoptera acutorostrata*), Pacific white-sided dolphins (*Lagenorhynchus obliquidens*), and Risso's dolphins (*Grampus griseus*) may be observed. See Table 7.1 for details on these special status marine species and for those taxa that are highly unlikely or not expected to occur in the Marine Study Area.

3.2.2 Sea Turtles

Physical and oceanographic forces drive patterns of primary and secondary productivity in the coastal waters off California (Wingfeld *et al.* 2011). Five species of marine sea turtles are known to inhabit these waters or seasonally migrate to the area to forage during times of high productivity. These include loggerhead (*Caretta caretta*), green (*Chelonia mydas*), leatherback (*Dermochelys coriacea*), Pacific hawksbill (*Eretmochelys imbricata*), and olive ridley (*Lepidochelys olivacea*) sea turtles (California Herps 2019).

Of these five species, only the olive ridley sea turtle has been reported to occur in the nearshore waters of Northern California, with sightings at Noyo in Mendocino County and near Table Bluff in Humboldt County (California Herps 2019). The loggerhead and Pacific hawksbill sea turtles are known to occur only in Southern California south of Point Conception. Green and leatherback sea turtles also are more commonly observed in the warmer waters off Mexico and Southern California. They have been occasionally observed as far north as Marin County in north Central California, with far rarer observations as far north as Canada's Vancouver Island (California Herps 2019).

The leatherback, green, and Pacific hawksbill sea turtles are federally listed as endangered throughout their ranges, and the olive rridley and loggerhead sea turtles are federally listed as

threatened. Critical habitat for the leatherback sea turtle has been established from Point Arena in north Central California south to Point Arguello, in Southern California (NOAA 2018b).

4 Intertidal and Nearshore Habitats

4.1 Sandy Beach

Sandy beach ecosystems account for approximately 70% of the shoreline of the entire California coastline and comprise 152.4 miles of the Northern California coast[1] (Horizon 2012; Dugan *et al* 2015; Nielsen *et al.* 2017). Sandy beach ecosystems can be separated into long beaches (> 1 kilometer [km] in length) and pocket beaches (<1 km in length). The beaches occurring in the Marine Study Area are identified as long beaches.

Sandy beaches provide critical habitat for shorebirds, marine mammals, and fishes; but they are often used by humans for recreation, and they help to support coastal economies. Numerous species of shorebirds, such as sanderlings, marbled godwits, and willets, feed along the water's edge on sandy beaches. Western snowy plovers and California least terns also are known to use sandy beaches and coastal dunes for nesting sites. Additionally, pinnipeds haul out on isolated beaches and sands spits, including gravel and fine- to medium-grained beaches (Horizon 2012).

Generally, beaches are highly dynamic environments exposed to air and sun during low tides; they are subject to intense wave-related energy and constant reworking, as well as large-scale seasonal substrate variations (Thompson *et al.* 1993). Organisms that live in the sand are mobile and frequently shift their distribution in response to daily fluctuations in temperature, salinity, and moisture content (Straughan and Hadley1978).

A variety of invertebrates live in the sand or in wracks of decaying seaweed and other detritus associated with the beach surface. The beaches of North Central and Northern California support a diverse invertebrate community with over 70 species reported in a recent scientific assessment (Nielsen *et al.* 2017). Sand crabs (*Emerita analoga*) and beach hoppers (*Megalorchesis* spp.) are typically the dominant invertebrate taxa present, accounting for up to 78% of total intertidal biomass. Other common taxa include polychaete worms and clams. Kelp wrack and other washed-up organic debris are the predominant energy and food sources for beach ecosystems (Nielsen *et al.* 2017).

4.2 Rocky Intertidal

There is no rocky intertidal habitat along the proposed RTI Eureka subsea cable routes. The closest rocky intertidal habitat is located along the man-made rock jetties lining the entrance to Humboldt Bay (Figure 1). Organisms inhabiting this type of rocky intertidal habitat typically include assorted barnacles (*Balanus and Chthamalus* spp.), mussels (*Mytilus californianus*),

[1] The north coast of California is defined as the coastline between Alder Creek in Mendocino County to the California-Oregon border.

limpets, chitons, small crabs, assorted sea stars, bryozoans, encrusting sponges, brown algae, snails, and hermit crabs (*Paguridae*) (RCEA 2018).

5 Subtidal Habitats and Associated Macrobenthic Biological Communities

Subtidal habitats typically are characterized as either soft sediment or hard substrate. Depending on water depth, currents, wave energy, and other physical conditions, the soft substrate can range from coarse sands (typically observed in high-energy, shallow-water environments) to fine muds (observed in low-energy, deeper water environments). Hard substrate can be divided into natural (rocky outcrop) or artificial (e.g., concrete, pilings, steel) substrate and further characterized by elevation or rise above the seafloor. While some reports characterize elevation rise as "mixed," "low," or "high" (Lee 2012; Henkel *et al.* 2014), more common descriptors used for categorizing elevation of hard substrate above the seafloor are:

- Mixed bottom – a combination of coarse sand, gravel, cobble, and small boulders;
- Low relief – exposed bedrock and rocky outcropping rising approximately < 0.3 m (<1 ft) from the seafloor;
- Moderate relief – exposed rocky outcroppings that typically rise approximately 0.3–1.0 m (1–3 ft) from the seafloor;
- High relief – exposed rocky outcropping that typically rise >1.0 m (>3 ft) from the seafloor.

Many of the deep-water, hard substrate biological assessments featured in this report have documented an increase in species diversity and abundance with increasing elevation above the seafloor. Moderate-relief rocky features tend to be isolated features surrounded by soft-bottom habitat, whereas high-relief features tend to be found in rocky areas surrounded by mixed-, low-, and moderate-relief habitat (SAIC 1999; SAIC 2000; AMS 2008; AMS 2016a). These studies also have identified that water depth, current speed, rate of sedimentation, and elevation off the seafloor are key factors in determining the composition of biota inhabiting a specific hard substrate habitat (Lissner and Shoakes 1986; Battelle Ocean Sciences 1991; Hardin *et al.* 1993; Lee 2012; Henkel *et al.* 2014).

Additionally, with increasing water depth and a reduction of wave energy above the seafloor, the sediment composition shifts from coarse sands with low organic content near the beach to fine muds with increasing organic content as one transits farther offshore into deeper waters. This shift in sediment composition and energy also results in changes to the marine biota inhabiting the soft substrate habitat.

5.1 Habitats and Associated Biota Observed in the 0–30 m (0–100 ft) Water Depth Range

Most fiber optic cables begin their offshore routing at the point at which the cable exits an existing pipeline/outfall or horizontal bore hole. Thtypically is occurs in 12–25 m (39–82 ft)

water depth and preferably in soft substrate such as sand or silt. Although hard substrate does occur at these shallower depths subject to higher wave energy, cable routes routinely are selected to avoid them. As a result, most of the fiber optic cable route reconnaissance surveys reviewed for this report begin at water depths greater than 25 m (82 ft). Investigations of shallow-water rocky reefs in Southern, Central, and Northern California have been conducted by Occidental College (2008), Chambers (1998), AMS (1999a), and Jenkins and Craig (2017); these studies can be used to inform our understanding of species present at water depths < 30 m (100 ft). Because scientists conducted these surveys using SCUBA equipment, the taxonomic lists generated from them typically are more extensive than lists generated from ROV-based surveys. The following discussion of biota in water < 30 m (100 ft) depth is based on the aforementioned studies and assessments using SCUBA, whereas discussions of biota in water > 30 m (100 ft) depth focuses primarily on observations and data originating from fiber optic cable route surveys and surveys of California's Marine Protected Areas (MPAs) in Central and Northern California.

5.1.1 Soft Substrate

Soft substrate habitat is composed of both infaunal[2] and epifaunal[3] taxa. Sediment composition commonly observed between 0 and 30 m (0 and 100 ft) depth include coarse sands in the surf zone shifting to finer sands and muds (silts and clays) at the deeper water depths of this zone (Figures 2 and 3). The infaunal community inhabiting this zone primarily consists of arthropods, mollusks, and polychaetes. The U.S. Environmental Protection Agency (EPA) reported (2016) that the infaunal community along stations ranging between 25 m (82 ft) and 92 m (302 ft) depth at the Humboldt Open Ocean Disposal Site (HOODS), located immediately offshore of the entrance to Humboldt Bay (Figure 1), exhibited a fairly distinct trend toward increasing organism density, as well as increasing taxon richness, with increasing depth. This depth-trend in infaunal organism density and richness reflected differences in both substrate type and energy, with shallower stations being subject to a higher-energy environment and sandy sediments compared with a lower-energy environment and finer grained, more carbon-rich substrate at the deeper water stations. The nearshore, coarser sand sediments were dominated by arthropods and mollusks, whereas the siltier seafloor sediments located farther offshore were dominated by polychaete worms (EPA 2016).

The most common epifaunal invertebrate taxa observed between 0 and 30 m (0 and 100 ft) include the ornate tube worm (*Diopatra ornata*), cancer crabs *(Cancer* sp.), slender crabs *(Cancer gracilis)*, masking crab *(Loxorhynchus crispatus)*, octopus *(Octopus rubescens* and *O. bimaculatus/bimaculoides)*), white sea pens (*Stylatula elongata*), sea cucumbers (*Parastichopus californicus*), sunflower stars (*Pycnopodia helianthoides*), occasional polychaete tube worms, Pachycerianthus anemones, spiny sand stars (*Astropecten armatus*), short-spined seastars (*Pisaster brevispinus*), sand stars (*Luidia foliolata*), sea pansy (*Renilla kollikeri*), swimming crabs (*Portunus xantusii*), hermit crabs, Kellet's whelk (*Kelletia kellettii*), and sand

[2] Infaunal – benthic organisms that live within the substrate or sediments of the seafloor.

[3] Epifaunal- benthic organisms that live on the seafloor surface of the substrate or sediment.

dollars (*Dendraster excentricus*) (SAIC 1999; MBARI 2004; AMS 2008; Lauerman *et al.* 2017; MARE 2017).

Additionally, the bat star (*Asterina miniata*) and red sea star (*Mediaster aequalis*) occasionally are observed present in soft substrate when the soft substrate habitat is close to exposed hard substrate. In coarser sand habitats, the invertebrate community typically is dominated by ornate tubeworms (*D. ornata*) and sand dollars (*D. excentricus*) when they are present in colonies occupying fairly narrow bands. In deeper waters, where the sediments shift to finer muds, brittle stars (*Ophiura* spp.) start to occur in larger numbers.

When hard substrate is in proximity to the surveyed location, various species of drift algae also are commonly observed along the seafloor in soft-bottom habitat. Observed species include bull kelp (*Nereocystis luetkeana*), feather boa kelp (*Egregia meanzinii*), acid kelp (*Desmarestia ligulata*), and surf grass (*Phyllospadix* spp.*)*. Populations of small red and brown algae also have been reported to occur attached to worm tubes (MBC 2001; AMS 2016a).

5.1.2 Hard Substrate

Hard substrate habitat types typically observed between 0 and 30 m (0 and 100 ft) water depths include mixed bottom with a combination of coarse sand and cobble and low-relief rocks (< 0.3 m [1 ft]) above the seafloor (Figure 4). No known or reported hard substrate occurs within this depth range offshore Eureka except along the rock jetties flanking the entrance to Humboldt Bay (RCEA 2018) and possible artificial hard substrate provided by sunken wrecks (Figure 1). However, if mixed- or low-relief rocky substrate were to occur along the proposed cable route between 0 and 30 m (0 and 100 ft) depth, the associated biological communities likely would be dominated by a dense mat of turf species including a mixture of small hydroids, bryozoans, tunicates, sponges, crustose and erect coraline algae, barnacles, and multiple species of red and brown algae according to surveys of North Coast MPAs (Jenkins and Craig 2017). For example, in their assessment of the Trinidad Head MPA, Jenkins and Craig (2017) reported that the dominant algae occurring in water depths less than 20 m (66 ft) included woody stem kelp (*Pterygophera californica*), brown algae (*Laminaria* spp.), brown kelp (*Cystosiera* spp.), and bull kelp (*Nereocystis luetkeana*).

Other invertebrate taxa that may be present at some locations where low- or mixed- relief rock outcroppings occur include surf grass (Phyllospadix *sp.)* in the very shallow water depths of this zone, sea anemones (*Actinaria unident.*), swimming anemones (*Stomphia coccinea*), squid (*Loligo* sp.), crab (*Cancer* spp.), masking crab (*L. crispatus*), bat stars (*Asterina miniata*), red sea stars (*M. aequalis)*, giant-spined sea stars (*Pisaster giganteus*), other *Pisaster* sea stars, brittle stars (*Ophiura* spp.) and occasionally sea hares (*Aplysia californica*) (AMS 2008; SAIC-SLO 1999; MBARI 2004).

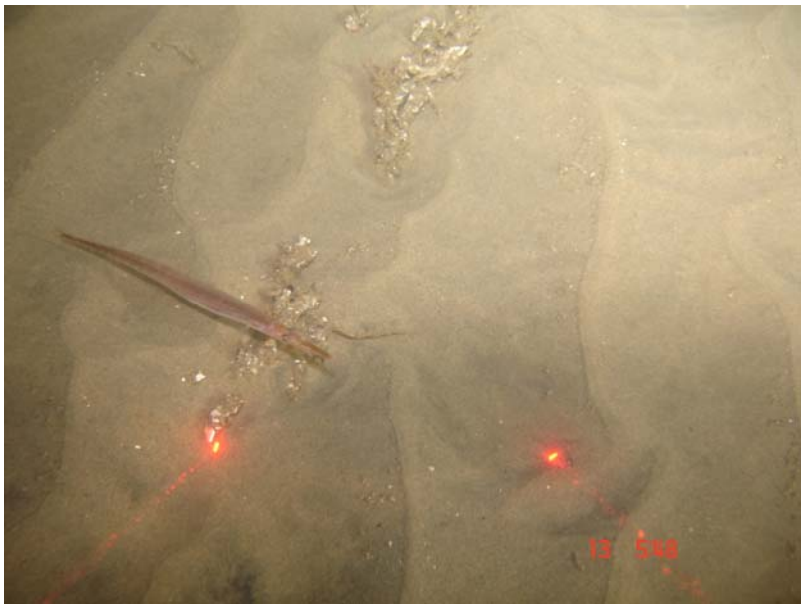

Figure 2: Coarse sand substrate in < 30 m of water depth offshore Central California. Ornate tube worms (*D. ornata*) and a tubesnout (*Aulorhynchus flavidus*) along the AAG-S5 cable route.

Figure 3: Coarse sand substrate in < 30 m water depth offshore Southern California. Drift kelp and ornate tube worms (*D. ornata*) along the SEA-US cable route.

Figure 4: Mixed-bottom, low-relief, hard substrate habitat in < 30 m of water depth offshore Central California along the SEA-US cable route.

5.2 Habitats and Associated Biota Observed in the 30–100 m (100-328 ft) Water Depth Range

5.2.1 Soft Substrate

Soft substrate habitats in the 30–100 m (100–328 ft) depth range, where bottom currents or wave energy continue to wash the seafloor in the shallower depths of the zone, include scattered mixed-bottom, coarse sand, silty sands, and fine silt-clay mud sediments. The coarser sand substrate normally is seen only at the shallower water depths of this segment of the nearshore environment. The finer mud substrate is frequently pockmarked with burrow holes (Figures 5 and 6).

Infaunal taxa inhabiting the soft sediments in this depth range are dominated by polychaete worms, crustaceans, and mollusks (EPA 1995, 2016). Dominant polychaete infaunal taxa, which accounted for up to 70% of individuals present, include *Siophanes bombyx*, *Decamastus gracilis*, *Glycera oxcephala*, *Heteromastus filobranchus*, *Lumbineris luti*, *Mediomastus californiensis*, *Scoloplos armiger*, *Spiphanes bombyx*, and *Tharyx* spp. (EPA 1995, 2016). Dominant infaunal crustacean taxa include the cumacean *Diastylopsis dawsonii*; the amphipods *Ampelisca careyi*, *Anisogammarus pugettensis*, *Atylus tridens*, *Monoculodes spinipes*, *Protomedia prudens*, *Photos* spp., *Diasylis* spp., *Cheirmedeia* spp., *and Isaeidae* spp.; and the isopod *Synidotea bicuspida*. Dominant molluscan infaunal taxa include the gastropods *Olivella pycna* and *Mitrella* spp.; bivalves *Axinopsida sericata*, *Macoma* spp., and S*iliqua patula*; and unidentified brittle stars (*Ophiuroids*) (EPA 1995, 2016).

Soft substrate epifauna reported occurring in these water depths include multiple species of decapod crustacean, such as bay shrimp (*Crangon* spp.) and coon-stripe shrimp (*Pandalus danae*), dungeness crab (*Metacarcinus magister*), sand dollars (*D. excentricus*) and several species of sea stars (EPA 2016, 1995). Sand dollars have been reported to occur in large, dense beds in the coarser sand sediments offshore Humboldt Bay (EPA 1995; Fenstermacher *et al.* 2001).

Based on seafloor surveys conducted by ROV, several species of sea pens (*Ptilosarcus gurneyi, Stylatula elongata, Acanthoptilum* spp., *Subselliflorae* spp., *Virgularia* spp.), sea slugs (*Pleurobranchea californica*), sand stars (*L. foliolata*), multi-armed sea stars (*Rathbunaster californica* and *Pycnopodia helianthoides*), Cerianthidae anemones, California sea cucumbers (*Apostichopus californicus* [formerly known as *Parastichopus californica]*), and swimming anemones (*Stomphia coccinea*) also occur at these water depths (Lauermann *et al.* 2017; SAIC 2000; Lee 2012; MARE 2017). In coarser sediments, brittle stars and the sunflower star (*Pycnopodia helianthoides*) predominate, and decapod crustacean taxa generally decline with depth offshore (EPA 2016).

5.2.2 Hard Substrate

Hard substrate habitat types typically observed in the 30–100 m (100–328 ft) depth range in the nearshore waters of California can include mixed-bottom, low-, moderate-, and high-relief rock. Although no hard substrate habitat is known to be present within these water depths offshore Eureka, it is possible that isolated small patches of mixed- or low-relief habitat is found along any of the proposed fiber optic cable routes. It is also possible that sunken shipwrecks located in these water depths offshore Eureka (Figure 1) would provide artificial hard substrate for sessile[4] marine taxa. Data from scientific assessments of nearby Central and North Coast MPAs, as well as other studies of hard substrate habitats and associated biological communities occurring within these depths can be used to characterize any hard substrate taxa that may be present. An assessment of multiple hard substrate habitats in the Pacific Northwest concluded that water temperature and latitude were interchangeable when characterizing the presence of individual taxa (Lee 2012).

The hard substrate community inhabiting rocky features between 30 and 100 m (100 and 328 ft) depth appears to be dominated by turf, encrusting and foliose bryozoans, assorted encrusting sponges, snails, and the white-plumed anemone *M. farcimen* (=*giganteum*) (Figure 6). Also occasionally occurring are brown cup corals (*P. stearnsii*), assorted crabs (*Cancer* spp.), shrimps, red sea stars (*M. aequalis*), sea cucumbers (*Parastichopus* spp.), the sunflower star (*Pycnopodia* sp.), the fish eating star (*Stylasterias forreri*), pink urchins (*Allocentrotus fragilis*), swimming anemones (*S. coccinea*), and brittle stars (*Ophiuroids*). Additionally, soft gorgonian corals including *Lophogorgia chiliensis* and *Eugorgia rubens* occasionally are observed as single or small multi-stalked specimens (SAIC 2000; Lee 2012; AMS 2008; Lauermann *et al.* 2017; MARE 2017).

[4] Sessile – marine taxa that are attached to hard substrate and not motile.

5.3 Habitats and Associated Biota Observed in the 91–200 m (300–656 ft) Water Depth Range

5.3.1 Soft Substrate

The soft seafloor substrate typically observed in the 91–200 m (300–656 ft) depth range and below is exclusively comprised of silts and clays, with minor amounts of fine sand (Figures 7 and 8). The macrobenthic community in this depth range is similar to that observed in the deeper depths of the 30–100 m (100–328 ft) range discussed above. It is dominated by sea pens (*S. elongata, Virgularia* spp.), sand stars (*L. foliolata*), assorted crabs including *Cancer* spp., *Paralithoides* spp., and *Metacarcinus magister*), and assorted shrimp. Other commonly or frequently occurring taxa include several species of sea anemones (e.g., *Urticina* spp.), the multi-armed sea star (*R. californica*), the red sea star (*M. aequalis*), brittle stars (*Amphiodia* sp. and Ophiuroidea), pink sea urchin (*Allocentrotus fragilis*), free-living polychaetes (*Chloeia pinnata*), sea cucumbers (*Parastichopus* spp.), several species of octopus (Octopoda) and sea slugs (*P. californica*) (SAIC 2000; AMS 2007; Lee 2012; Lauermann *et al.* 2017; MARE 2017; Henkel 2014).

5.3.2 Hard Substrate

Hard substrate habitat types observed in the 91–200 m (328–656 ft) depth range are the same as those present in the 30–100 m (100–328 ft) depth range. As illustrated in Figure 1, hard substrate features occur offshore Eureka, California between 200 and 500 m (656 and 1,640 ft) and again between 500 and 1,000 m (1,640 and 3,281 ft). This farther offshore grouping of rocky features occurs within the planned federal wind energy lease area. All of this hard substrate habitat is identified by the National Fisheries Management Service (NMFS) as Habitat Areas of Particular Concern (HAPCs) under the Magnuson-Stevens Fishery Management and Conservation Act. As noted in Figure 1, it is the intent of the RTI Eureka Subsea Cables Project to avoid any moderate- to high-relief hard substrate areas that might occur along any of the proposed cable routes.

The macrobenthic taxa inhabiting water depths between 91 and 200 m (328 and 656 ft) are similar to those encountered in the 30–100 m (100–328 ft) depth range with turf, cup corals, bryozoans, sponges, tunicates, and the white-plumed anemone being the most often observed. Also commonly observed are giant basket stars (*Gorgonocephalus eucnemis*), brittle stars (Ophiuroidea), various species of crabs and red sea stars (*M. aequalis*). At some locations, where moderate- to high-relief rock outcrops may be present, crinoids (e.g., *F. serratissima*), soft gorgonian corals, the California hydrocoral *Stylaster californicus* (= *Allopora californica)* become more frequent (Lauerman *et al.* 2017; SAIC 2000; Lee 2012; MARE 2017).

It is within these water depths that deep-water branching corals have been reported occurring along fiber optic cable routes (SAIC 2000). Based on whether current speeds, sedimentation rates, and the occurrence of high-relief features are favorable, branching hard and soft corals have been reported, including the branching white coral *Lophelia* sp. (NOAA 2014a).

Figure 5: Soft substrate habitat in 30–100 m water depth offshore Southern California along the SEA-US Cable Route. Left Photo-shell hash and drift algae. Right photo-*Acanthoptilum* spp. sea pens.

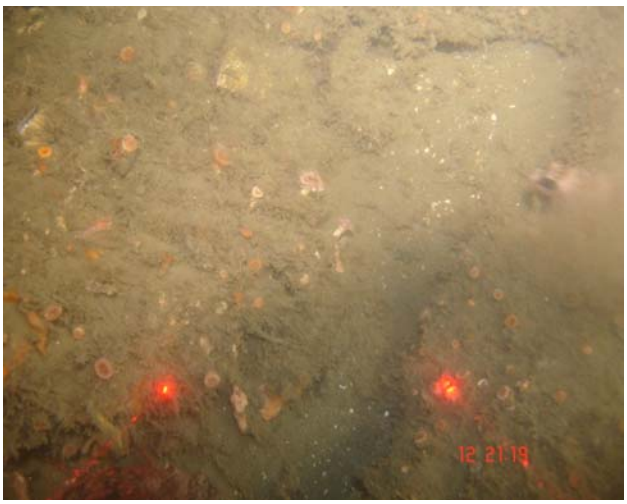

Figure 6: Natural and artificial hard substrate habitat in 30–100 m water depth offshore Southern (left photo) and Central California (right photo). Left photo-debris with attached turf species, *Metridium farcmens* anemone, crab, and rockfish along the SEA-US Cable Route. Right photo- low shelf with turf, cup corals (*Balanophyllia elegans*), sponges, and bryozoans along the AAG-S5 Cable Route.

Figure 7: Fine silt and clay soft substrate in100–185 m water depth offshore Southern California. Pink urchins (*Strongylocentrotus fragilis*) along the SEA-US

Figure 8: Fine silt and clay soft substrate in 100–183 m water depth offshore Central California. Spiny sand star (*Astropecten* sp.) and brittle stars along the AAG-S5 cable

6 Fish Assemblages

The distribution of fish species offshore California is influenced by various combinations of water depth, substrate type, temperature, and ocean currents (Love and Yoklavich 2006). Fish assemblages along the Central California coast have not been extensively researched, and most data are based on commercial and recreational landing data. These data, combined with data from ROV reconnaissance surveys along fiber optic cable routes, are the primary basis for describing fish assemblages in this paper. Although many marine resources, including fishes, typically are distributed by water depth and habitat type, the following description of fish assemblages is divided by substrate type.

6.1 Pelagic (Open Water)

Pelagic fish assemblages tend to be similar throughout the coastal waters of Northern California, characterized by small schooling species such as Pacific sardine (*Sardinops sagax*), Northern anchovy (*Engraulis mordax*), and smelt (Osmeridae); schooling predators such as bluefin tuna (*Thunnus thynnus*), albacore tuna (*Thunnus alalonga*), and thresher shark (*Alopias vulpinus*); and large solitary predators such as mako shark (*Isurus oxyrinchu*), leopard shark (*Triakis semifasciata*), and great white shark (*Carcharodon carcharias*), (CDFW 2018). Other common fish species that inhabit the open water environment include assorted salmon (*Oncorhynchus* spp.*),* steelhead (*Onchorhynchus mykiss irideus*), market squid (*Doryteuthis opalescens*), jack and Pacific mackerel (*Trachurus symmetricus* and *T. symmetricus*), opah (*Lampris* spp.), juvenile and adult rockfishes, and assorted perches *(*Embiotocidae*).*

6.2 Subtidal Soft Substrate

Soft bottom habitat is the most widespread benthic habitat on the California shelf (Allen 2006; Allen *et al.* 2011; Dugan *et al*. 2015). Demersal fishes occupying this habitat are relatively sedentary compared to pelagic fish species and respond more readily to changes in the benthic environment. Fishes found in soft-bottom habitats in Northern California are typified by flatfishes such as sanddabs, including speckled (*Citharichthys stigmaeus*) and Pacific (*C. sordidus*), Dover sole (*Microstomus pacificus*), English sole (*Pleuronectes vetulas*), assorted soles (Pleuronectidae), California halibut (*Paralichthys californicus*), poachers (Agonidae), tubesnout (*Aulorhynchus flavidus*), spotted cuskeels (*Chilara taylori*), longspine combfish (*Zaniolepsis latispinnus*), black eyed goby (*C. nicholsi*), Pacific hagfish (*Eptatretus stouti*), spotted ratfish (*Hydrolagus colliei*), California tonguefish (*Symphurus atricauda*), Pacific electric ray (*Torpedo californica*), banded guitarfish (*Zapteryx exasperate*), and eelpouts (*Lycodes* spp.) (AMS 2008; AMS 1999a; Chambers 1998; SAIC-SLO 1999; SAIC 1999; SAIC 2000; Lee 2012; MARE 2017). Larger predators include the big skate (*Raja binoculata*), longnose skate (*R. shina*), Pacific angel shark (*Squatina californica*), swell shark (*Cephaloscyllium ventriosum*), and great white shark (*Carcharodon carcharias).* As discussed above for fish species associated with hard substrate habitat, water depths <200 m (656 ft) do not appear to be a deterrent for soft substrate-associating fish.

6.3 Subtidal Hard Substrate

Similar to macroinvertebrate communities discussed above, fish assemblages in Northern California also are highly variable depending on both abiotic and biotic parameters, including the presence of reef structure (Pondella *et al.* 2011). Common fish species observed inhabiting or associating with hard substrate habitat, including both mixed bottom, low relief, and high relief, include sculpins (Cottidae) such as bull sculpin (*Enophrys taurine*) and coraline sculpin (*Artedius corallines*), black eyed goby (*Coryphopterus nicholsi*), giant kelpfish (*Heterostichus rostratus*), rainbow seaperch (*Hypsurus caryi*), white seaperch (*Platchthys stellatus*), pile perch (*Rhacochilus vacca*), pink surfperch (*Zalembius rosaceus*), kelp bass *(Paralabrax clathratus),* painted greenling *(Oxylebius pictus),* lingcod *(Ophiodon elongates),* and señorita (*Oxyjulis californi*a) (Chambers 1998; AMS 1999a; SAIC-SLO 1999; SAIC 1999; SAIC 2000; AMS 2008; Henkel 2014; MARE 2017).

The most common fish assemblages observed occurring on deeper water hard substrate outcroppings are assorted juvenile and adult rockfishes, including the brown rockfish (*Sebastes auriculatus*), gopher rockfish (*S. carnatus*), copper rockfish (*S. caurinus*), green striped rockfish (*S. elongates),* quillback rockfish (*S. maliger),* rosy rockfish (*S. rosaceus),* half banded rockfish (S. *semicinctus*), olive rockfish (*S. serrinoides),* and tree fish (*S. serriceps)* (AMS 1999a; Chambers 1998; SAIC-SLO 1999; SAIC 1999; SAIC 2000; AMS 2008; Henkel 2014; MARE 2017). Fish species typically observed associated with hard substrate do not appear to be as restricted by water depth as soft substrate taxa, at least to 200 m (656 ft). If any water depth delineation occurs in nearshore California waters. it appears to occur between water depths < 30 m (100 ft) and > 30 m (100 ft).

Other schooling fish species that have been observed or collected close to hard-bottom substrate areas include poachers (Agonidae), blue rockfish (*S. mystinus*), schooling baitfish (Atherindae), and speckled sanddabs (*Citharichthys stigmaeus*) (Chambers 1998; AMS 1999a; SAIC-SLO 1999; SAIC 1999; SAIC 2000; AMS 2008; Henkel 2014; MARE 2017). These same species are expected to occur in the vicinity of hard-bottom features along the RTI Eureka Subsea Cables Project offshore cable routes.

6.4 Magnuson-Stevens Act Managed Fish Species

In accordance with the 1996 amendments to the Magnuson-Stevens Fishery Management and Conservation Act, essential fish habitat (EFH) is defined as “those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity.” Central California coincides with areas designated as EFH in all four fishery management plans (FMPs): the Pacific Coast Groundfish FMP (PFMC 2016b), the Coastal Pelagic Species FMP (PFMC 2018a), Pacific Coast Salmon FMP (PFMC 2016a), and Highly Migratory Species FMP (PFMC 2018b).

Most of the 85 groundfish species managed under the Pacific Groundfish FMP are found at various stages in their life histories in diverse habitats throughout Northern California. Some species are broadly dispersed during specific life stages, especially those with pelagic eggs and larvae, while other species may have limited distributions (i.e., adult rockfishes in nearshore habitats) with strong affinities to a particular location or substrate type. Estuaries, sea grass beds,

canopy kelp, rocky reefs, and other "areas of interest" such as seamounts, offshore banks, canyons are designated as HAPCs for groundfish managed species. Figure 1 illustrates the locations of NMFS-designated HAPCs along the Northern California coast and specifically those occurring along the proposed RTI Eureka Subsea Cables Project cable routes.

Coastal pelagic fish species live in the water column, not near the sea floor, and usually are found from the surface to > 1,000 m (3,281 ft) water depth (PFMC 2018a). Six stocks of coastal pelagic fish species are managed under the Coastal Pelagic Species FMP, including jack mackerel (*Traxchurus symmetricus*), Pacific chub mackerel (*Scomber japonicas*), Pacific sardine (*Sardinops sagax*), market squid (*Doryteuthis opalescens*), northern anchovy (*E. mordax)* and krill or euphausiids (*Euphausia* spp., *Thysanoessa* spp., *Nyctiphanes simplex*, and *Nematocelis difficilis*). In addition, jacksmelt (*Atherinopsis californiensis*) and Pacific herring (*Clupea pallasii*) are considered ecosystem components of the fishery and are monitored. All of these species are observed in the coastal waters offshore Humboldt Bay (Tables 6.2 and 6.3 below).

The Pacific Coast Salmon FMP (2016) outlines spatially explicit EFH for Chinook salmon (*Oncorhynchus tshawytscha*), Coho salmon (*Oncorhynchus kisutch*), and Puget Sound pink salmon (*Oncorhynchus* gorbuscha). While inland spawning habitat is considered the most essential to these species (all areas designated as HAPC for salmon are inland), all three are still present in marine coastal waters. The marine EFH for all three species extends from the inland extreme high tide line out to the 200-mile Exclusive Economic Zone offshore of the states of Washington, Oregon, and California north of Point Conception. Humboldt Bay is therefore located within the boundary of this EFH. Chinook salmon are more commonly found off the coast of California, but Coho and Puget Sound pink salmon, while uncommon, also can be present.

EFH for Highly Migratory Species includes all marine waters from the shoreline to 200 nautical miles (370 km) offshore. Three species of shark are managed under the Highly Migratory Species FMP: the blue shark (*Prionace glauca*), common thresher shark (*Alopias vulpinus*), and shortfin mako shark (*Isurus oxyrinchus*). Additionally, five species of tuna are managed under this plan, including bigeye tuna (*T. obesus*), North Pacific albacore (*Thunnus alalunga*), Pacific bluefin tuna (*T. orientalis*), yellowfin tuna (*T. albacares*), and skipjack tuna (*Katsuwonus pelamis*) (Table 6.1). Striped marlin (*Kajikia audax*) is the only species of billfish managed under the Highly Migratory Species FMP. Broadbill swordfish (*Xiphias gladius*) is the only species of swordfish and Dorado/mahi-mahi (*Coryphaena hippurus*) is the only species of dolphinfish managed under this FMP. All of the highly migratory species occur in offshore waters adjacent to Humboldt Bay (Tables 6.2 and 6.3 below).

TABLE 6.1
MAGNUSON-STEVENS ACT MANAGED FISH AND INVERTEBRATE SPECIES

Fisheries Management Plan	Species, Common Name	Species, Scientific Name	Life Stage	Occurrence in Proximity to Eureka Site*
Coastal Pelagic	Jack mackerel	*Trachurus symmetricus*	E, L, J, A	Present[1]
	Jacksmelt	*Atherinopsis californiensis*	E, L, J, A	Present[1,2]
	Krill or Euphausiids	*Euphausia pacifica, Thysanoessa spinifera, Nyctiphanes simplex, Nematocelis difficilis, T. gregaria, E. recurva, E. gibboides, E. eximia*	E, F, J, A	Present[3]
	Market squid	*Doryteuthis opalescens*	E, L, J, A	Present [1,2]
	Northern anchovy	*Engraulis mordax*	E, L, J, A	Present[1]
	Pacific herring	*Clupea pallasii pallasii*	E, L, J, A	Present[1]
	Pacific (chub) mackerel	*Scomber japonicus*	E, L, J, A	Present[1,2,4]
	Pacific sardine	*Sardinops sagax*	E, L, J, A	Present[1]
Pacific Groundfish (dashed lines separate elasmobranchs, roundfishes, rockfishes, and flatfishes, respectively)	Cabezon	*Scorpaenichthys marmoratus*	E, L, J, A	Present[1,2,4]
	Kelp greenling	*Hexagrammos decagrammus*	E, L, J, A	Present[1,2,,4]
	Lingcod	*Ophiodon elongatus*	E, L, J, A	Present[1,2,4]
	Pacific cod	*Gadus macrocephalus*	E, L, J, A	Present[1,2]
	Pacific whiting (hake)	*Merluccius productus*	E, L, J, A	Present[1,2]
	Sablefish	*Anoplopoma fimbria*	E, L, J, A	Present[1,2]
	Aurora rockfish	*Sebastes aurora*	E, L, J, A	Absent[1]
	Bank rockfish	*Sebastes rufus*	E, L, J, A	Present[1]
	Black rockfish	*Sebastes melanops*	E, L, J, A	Present [2,4]
	Black-and-yellow rockfish	*Sebastes chrysomelas*	E, L, J, A	Present[2,4]
	Blackgill rockfish	*Sebastes melanostomus*	E, L, J, A	Present [2]
	Blue rockfish	*Sebastes melanostomus*	E, L, J, A	Present [2,4]
	Bocaccio rockfish	*Sebastes paucispinis*	E, L, J, A	Present [2,4]
	Bronzespotted rockfish	*Sebastes gilli*	E, L, J, A	Absent[1]

TABLE 6.1 (CONTINUED)
MAGNUSON-STEVENS ACT MANAGED FISH AND INVERTEBRATE SPECIES

Fisheries Management Plan	Species, Common Name	Species, Scientific Name	Life Stage	Occurrence in Proximity to Eureka Site*
	Brown rockfish	*Sebastes auriculatus*	E, L, J, A	Present [2,4]
	Calico rockfish	*Sebastes dalli*	E, L, J, A	Absent[1]
	California scorpionfish	*Scorpaena guttata*	E, L, J, A	Absent[1]
	Canary rockfish	*Sebastes pinniger*	E, I, J, A	Present [2,4]
	Chameleon rockfish	*Sebastes phillipsi*	E, L, J, A	Absent[1]
	Chillipepper rockfish	*Sebastes goodei*	E, L, J, A	Present [2]
	China rockfish	*Sebastes nebulosus*	E, L, J, A	Present [2,4]
	Copper rockfish	*Sebastes caurinus*	E, L, J, A	Present [2,4]
	Cowcod	*Sebastes levis*	E, L, J, A	Present [2]
	Darkblotched rockfish	*Sebastes crameri*	E, L, J, A	Present [2]
	Deacon rockfish	*Sebastes diaconus*	E, L, J, A	Present[1]
	Dusky rockfish	*Sebastes ciliatus*	E, L, J, A	Absent[1]
	Dwarf-red rockfish	*Sebastes rufinanus*	E, L, J, A	Absent[1]
	Flag rockfish	*Sebastes rubrivinctus*	E, L, J, A	Absent[1]
	Freckled rockfish	*Sebastes lentiginosus*	E, L, J, A	Absent[1]
	Gopher rockfish	*Sebastes carnatus*	E, L, J, A	Present [2,4]
	Grass rockfish	*Sebastes rastrelliger*	E, L, J, A	Present [2,4]
	Greenblotched rockfish	*Sebastes rosenblatti*	E, L, J, A	Absent[1]
	Greenspotted rockfish	*Sebastes chlorostictus*	E, L, J, A	Present [2]
	Greenstriped rockfish	*Sebastes elongatus*	E, L, J, A	Present [2]
	Harlequin rockfish	*Sebastes variegatus*	E, L, J, A	Absent[1]
	Halfbanded rockfish	*Sebastes semicinctus*	E, L, J, A	Absent[1]
	Honeycomb rockfish	*Sebastes umbrosus*	E, L, J, A	Absent[1]
	Kelp rockfish	*Sebastes atrovirens*	E, L, J, A	Absent[1]

TABLE 6.1 (CONTINUED)
MAGNUSON-STEVENS ACT MANAGED FISH AND INVERTEBRATE SPECIES

Fisheries Management Plan	Species, Common Name	Species, Scientific Name	Life Stage	Occurrence in Proximity to Eureka Site*
	Longspine thornyhead	*Sebastolobus altivelis*	E, L, J, A	Present [2]
	Mexican rockfish	*Sebastes macdonaldi*	E, L, J, A	Absent[1]
	Olive rockfish	*Sebastes serranoides*	E, L, J, A	Present [2,4]
	Pacific Ocean perch	*Sebastes alutus*	E, L, J, A	Present [2]
	Pink rockfish	*Sebastes eos*	E, L, J, A	Absent[1]
	Pinkrose rockfish	*Sebastes simulator*	E, L, J, A	Absent[1]
	Quillback rockfish	*Sebastes maliger*	E, L, J, A	Present [2,4]
	Redbanded rockfish	*Sebastes babcocki*	E, L, J, A	Present [2]
	Redstripe rockfish	*Sebastes proriger*	E, L, J, A	Present [1]
	Rosethorn rockfish	*Sebastes helvomaculatus*	E, L, J, A	Present [2]
	Rosy rockfish	*Sebastes rosaceus*	E, L, J, A	Present [2,4]
	Rougheye rockfish	*Sebastes aleutianus*	E, L, J, A	Present[1]
	Sharpchin rockfish	*Sebastes zacentrus*	E, L, J, A	Present[1]
	Shortbelly rockfish	*Sebastes jordani*	E, L, J, A	Present[1]
	Shortraker rockfish	*Sebastes borealis*	E, L, J, A	Present [2]
	Shortspine thornyhead	*Sebastolobus alascanus*	E, L, J, A	Present [2]
	Silvergray rockfish	*Sebastes brevispinis*	E, L, J, A	Present[1]
	Speckled rockfish	*Sebastes ovalis*	E, L, J, A	Present[1]
	Splitnose rockfish	*Sebastes diploproa*	E, L, J, A	Present[1]
	Squarespot rockfish	*Sebastes hopkinsi*	E, L, J, A	Absent[1]
	Sunset rockfish	*Sebastes crocotulus*	E, L, J, A	Present[1]
	Starry rockfish	*Sebastes constellatus*	E, L, J, A	Present [2]
	Stripetail rockfish	*Sebastes saxicola*	E, L, J, A	Present [2]
	Swordspine rockfish	*Sebastes ensifer*	E, L, J, A	Absent[1]
	Tiger rockfish	*Sebastes nigrocinctus*	E, L, J, A	Present [4]

TABLE 6.1 (CONTINUED)
MAGNUSON-STEVENS ACT MANAGED FISH AND INVERTEBRATE SPECIES

Fisheries Management Plan	Species, Common Name	Species, Scientific Name	Life Stage	Occurrence in Proximity to Eureka Site*
	Treefish rockfish	*Sebastes serriceps*	E, L, J, A	Absent[1]
	Vermillion rockfish	*Sebastes miniatus*	E, L, J, A	Present [2,4]
	Widow rockfish	*Sebastes entomelas*	E, L, J, A	Present [2,4]
	Yelloweye rockfish	*Sebastes ruberrimus*	E, L, J, A	Present [2,4]
	Yellowmouth rockfish	*Sebastes reedi*	E, L, J, A	Absent[1]
	Yellowtail rockfish	*Sebastes flavidus*	E, L, J, A	Present [2,4]
	Big skate	*Raja binoculata*	E, L, J, A	Present [2]
	Leopard shark	*Triakis semifasciata*	E, L, J, A	Present [2,4]
	Longnose skate	*Raja rhina*	E, L, J, A	Present [2]
	Spiny dogfish	*Squalus suckleyi*	E, L, J, A	Present [2,4]
	Arrowtooth flounder (turbot)	*Atheresthes stomias*	E, L, J, A	Present [2,4]
	Butter sole	*Isopsetta isolepis*	E, L, J, A	Present [2]
	Curlfin sole	*Pleuronichthys decurrens*	E, L, J, A	Present [2]
	Dover sole	*Microstomus pacificus*	E, L, J, A	Present[2,4]
	English sole	*Parophrys vetulus*	E, L, J, A	Present [2]
	Flathead sole	*Hippoglossoides elassodon*	E, L, J, A	Present[1]
	Pacific sanddab	*Citharichthys sordidus*	E, L, J, A	Present [2,4]
	Petrale sole	*Eopsetta jordani*	E, L, J, A	Present [2,4]
	Rex sole	*Glyptocephalus zachirus*	E, L, J, A	Present [2]
	Rock sole	*Lepidopsetta bilineata*	E, L, J, A	Present [2]
	Sand sole	*Psettichthys melanostictus*	E, L, J, A	Present [2,4]
	Starry flounder	*Platichthys stellatus*	E, L, J, A	Present [2,4]

TABLE 6.1 (CONTINUED)
MAGNUSON-STEVENS ACT MANAGED FISH AND INVERTEBRATE SPECIES

Fisheries Management Plan	Species, Common Name	Species, Scientific Name	Life Stage	Occurrence in Proximity to Eureka Site*
Salmon	Chinook salmon	*Oncorhynchus tshawytscha*	A	Present[1]
	Coho salmon	*Oncorhynchus kisutch*	A	Present[1]
	Pink salmon	*Oncorhynchus gorbuscha*	A	Present[1]
Highly Migratory	Bigeye tuna	*Thunnus obesus*	A	Present[1]
	Blue shark	*Prionace glauca*	A	Present[1]
	Common thresher shark	*Alopias vulpinus*	A	Present[1]
	Dorado (Mahi-mahi, Dolphinfish)	*Coryphaena hippurus*	A	Present[1]
	North Pacific albacore	*Thunnus alalunga*	A	Present[1]
	Pacific bluefin tuna	*Thunnis orientalis*	A	Present[1]
	Shortfin mako (Bonito) shark	*Isurus oxyrinchus*	A	Present[1]
	Skipjack tuna	*Katsuwonus pelamis*	A	Present[1]
	Swordfish	*Xiphias gladius*	A	Present[1]
	Striped marlin	*Tetrapturus audax*	A	Present[1]
	Yellowfin tuna	*Thunnus albacares*	A	Present[1]
All Fishery Management Plans	Mesopelagic fishes	Families*: Myctophidae, Bathyalgidae, Paralepididae,* and *Gonostomatidae*		Absent[1]
	Pacific sand lance	*Ammodytes hexapterus*	E, L, J, A	Present[1]
	Pacific saury	*Cololabis saira*	E, L, J, A	Present[1]
	Pelagic squids	Families*: Cranchiidae, Gonatidae, Histioteuthidae, Octopoteuhidae, Ommastrephidae* except Humboldt squid *(Dosidicus gigas), Onychoteuthidae,* and *Thysanoteuthidae*	E, L, J, A	Present[5]
	Round herring	*Etrumeus teres*		Absent[1]

TABLE 6.1 (CONTINUED)
MAGNUSON-STEVENS ACT MANAGED FISH AND INVERTEBRATE SPECIES

Fisheries Management Plan	Species, Common Name	Species, Scientific Name	Life Stage	Occurrence in Proximity to Eureka Site*
	Silversides	*Atherinopsidae*		Absent[1]
	Smelts	*Osmeridae*	E, L, J, A	Present[1]
	Thread herring	*Opisthonema libertate, Opisthonema medirastre*		Absent[1]

NOTES:

E = Egg, **L** = Larvae, **J** = Juvenile, **A** = Adult

OCCURRENCE:

Present = Species found within the marine study area based on sources listed below

Absent = Not found within marine study area based on sources listed below

SOURCES:

Froese, R. and D. Pauly. Editors. 2019. FishBase. World Wide Web electronic publication. www.fishbase.org, version (04/2019)[1]; CDFW Final California Commercial Landings Table 9, 2013 – 2017[2]; Euphausiids of the World Ocean E. Brinton, M.D. Ohman, A.W. Townsend, M.D. Knight and A.L. Bridgeman[3]; PSMFC RecFIN Recreational Landings for Humboldt County, 2013 – 2018[4] Palomares, M.L.D. and D. Pauly. Editors. 2019. SeaLifeBase.World Wide Web electronic publication.www.sealifebase.org.

6.5 Commercial and Recreational Fishing

The coastal waters of Northern California are used extensively for both commercial and recreational fishing. Although more than 90 fish species or groups were commercially landed at Eureka between 2013 and 2018, only 12 of them accounted for 91% of the landings based on tonnage (Table 6.2). Those taxa that account individually for more than 0.7% of the total landings between 2013 and 2018 include Dungeness crab (*Metacarcinus magister),* ocean pink shrimp (*Pandalus jordani*), Dover sole (*M. pacificus),* market squid (*Doryteuthis opalescens),* sablefish (*Anoplopoma fimbria),* Petrale sole (*E. jordani),* hagfish (Myxini), longnose skate (*Raja rhina*), longspine thornyhead *(S. altivelis),* night smelt (*Spirinchus starksi*), shortspine thornyhead (*Sebastolobus alascanus),* and albacore tuna (*Thunnus alalonga*). Commercial fishing methods include trolling, trawling, and trapping.

TABLE 6.2
EUREKA, CALIFORNIA ANNUAL COMMERCIAL LANDINGS IN THOUSAND POUNDS: CDFW 2013 – 2018

Species		Commercial Landings (thousand pounds)							
Common Name	**Genus Species**	**2018**	**2017**	**2016**	**2015**	**2014**	**2013**	**Mean**	**Percent Total Catch**
Crab, Dungeness	Metacarcinus magister	13,474	0.96	9,828	509	4,616	20,062	8,082	34.4
Shrimp, ocean pink	Pandalus jordani	4913	3,275	2,011	7,647	8,466	8,502	5,802	24.7
Sole, Dover	Microstomus pacificus	3166	3,114	3,128	2,783	2,508	2,852	2,925	12.5
Squid, market	Doryteuthis opalescens	0.00	0.00	0.00	0.00	4,795	0.00	799	3.4
Sablefish	Anoplopoma fimbria	630	845	927	822	696	652	762	3.2
Sole, Petrale	Eopsetta jordani	892	844	668	599	591	499	682	2.9
Hagfish	Myxini	560	651	438	604	593	557	567	2.4
Skate, longnose	Raja rhina	21	278	264	2,239	175	16	499	2.1
Thornyhead, longspine	Sebastolobus altivelis	217	383	47	510	610	569	389	1.7
Smelt, night	Spirinchus starksi	281	288	275	387	303	312	308	1.3
Thornyhead, shortspine	Sebastolobus alascanus	202	189	237	274	292	295	248	1.1
Tuna, albacore	Thunnus alalunga	219	194	102	31	521	209	213	0.9
Lingcod	Ophiodon elongatus	350	245	82	83	70	40	145	0.6
Flounder, arrowtooth	Atheresthes stomias	52	85	116	17	126	172	95	0.4
Sole, rex	Glyptocephalus zachirus	127	165	128	77	81	75	109	0.5
Rockfish, black	Sebastes melanops	95	120	134	217	0	66	105	0.4
Sole, English	Parophrys vetulus	110	209	123	97	55	37	105	0.4
Rockfish, widow	Sebastes entomelas	518	108	0.28	1	0.32	0.18	105	0.4
Salmon, Chinook	Oncorhynchus tshawytscha	87	4	12	69	157	279	101	0.4
Rockfish, canary	Sebastes pinniger	305	165	1	9	2	1	81	0.3
Smelt, surf	Hypomesus pretiosus	2	1	6	104	223	57	66	0.3
Shrimp, coonstripe	Pandalus danae	82	56	54	37	82	81	65	0.3
Rockfish, group shelf	Sebastes	215	58	5	6	7	1	49	0.2

TABLE 6.2 (CONTINUED)
EUREKA, CALIFORNIA ANNUAL COMMERCIAL LANDINGS IN THOUSAND POUNDS: CDFW 2013 – 2018

SOURCES:

California Department of Fish and Wildlife Final California Commercial Landings, Table 14MB: 2013 – 2017. Species shown account for 99% of mean annual commercial landings in pounds in the Eureka area. Fished species and families comprising the remaining 1% from greatest to least include big skate (*Beringraja binoculata*), rockfish group slope (*Sebastes*), sanddab (Citharichthys), darkblotched rockfish (*Sebastes crameri*), Pacific hagfish (*Eptatretus stoutii*), grenadier (Macrouridae), redtail surfperch (*Amphistichus rhodoterus*), yellowtail rockfish (*Sebastes flavidus*), Bocaccio (*Sebastes paucispinis*), blue rockfish (*Sebastes mystinus*), chilipepper rockfish (*Sebastes goodei*), Pacific sanddab (*Citharichthys sordidus*), starry flounder (*Platichthys stellatus*), California halibut (*Paralichthys californicus*), vermillion rockfish (*Sebastes miniatus*), Cabezon (*Scorpaenichthys marmoratus*), copper rockfish (*Sebastes caurinus*), purple sea urchin (*Strongylocentrotus purpuratus*), quillback rockfish (*Sebastes maliger*), curlfin turbot (*Pleuronichthys decurrens*), Pacific halibut (*Hippoglossus stenolepis*), Pacific whiting (*Merluccius productus*), thresher shark (*Alopias vulpinus*), shortfin mako shark (*Isurus oxyrinchus*), swordfish (*Xiphias gladius*), kelp greenling (*Hexagrammos decagrammus*), red sea urchin (*Mesocentrotus franciscanus*), spiny dogfish shark (*Squalus acanthias*), China rockfish (*Sebastes nebulosus*), redbanded rockfish (*Sebastes babcocki*), rougheye rockfish (*Sebastes aleutianus*), grass rockfish (*Sebastes rastrelliger*), sand sole (*Psettichthys melanostictus*), blackgill rockfish (*Sebastes melanostomus*), curlfin sole (*Pleuronichthys decurrens*), brown rockfish (*Sebastes auriculatus*), Pacific Ocean perch rockfish (*Sebastes alutus*), bluefin tuna (*Thunnus thynnus*), olive rockfish (*Sebastes serranoides*), Pacific cod (*Gadus macrocephalus*), black and yellow rockfish (*Sebastes chrysomelas*), California moray eel (*Gymnothorax mordax*), shortraker rockfish (*Sebastes borealis*), striped surfperch (*Embiotoca lateralis*), calico surfperch (*Amphistichus koelzi*), jacksmelt (*Atherinopsis californiensis*), red rock crab (cancer *productus*), rosy rockfish (*Sebastes rosaceus*), skipjack tuna (*Katsuwonus pelamis*), gopher rockfish (*Sebastes carnatus*), rock sole (*Lepidopsetta bilineata*), Louvar (*Luvarus imperialis*), striped seaperch (*Embiotoca lateralis*), aurora rockfish (*Sebastes aurora*), greenstriped rockfish (*Sebastes elongatus*), Cowcod rockfish (*Sebastes elongatus*), barred surfperch (*Amphistichus argenteus*), white seabass (*Atractoscion nobilis*), Pacific mackerel (*Trachurus symmetricus*), walleye surfperch (*Hyperprosopon argenteum*), spotted ratfish (*Hydrolagus colliei*), greenspotted rockfish (*Sebastes chlorostictus*), yellowtail (*Seriola quinqueradiata*), leopard shark (*Triakis semifasciata*), flag rockfish (*Sebastes rubrivinctus*), bat ray (*Myliobatis californica*), rosethorn rockfish (*Sebastes helvomaculatus*), starry rockfish (*Sebastes constellatus*), brown smoothhound shark (*Mustelus henlei*), butter sole (*Plueronectes isolepis*), slender sole (*Lyopsetta exilis*), and pile surfperch (*Rhacochilus vacca*).

Recreational fishing, conducted from rocky shores, sandy beaches, docks, private boats, and commercial party boats, landed approximately 100 fish taxa between 2013 and 2018 (Table 6.3). However, only 19 of these taxa accounted for more than 91% of the landings in tonnage or in individual numbers of fish landed. The dominant fish taxa caught by recreational fisherman include lingcod (*O. elongates*); assorted species of rockfishes including blue, vermillion, yellowtail, gopher, copper, brown, black, olive, Boccacio, kelp, and Canary (*S. mystinus, S. miniatus, S. flavidus, S. caratus, S. caurinus, S. auriculatus, S. malanops, S. serranoides, S. paucispinis, S. astrovirens,* and *S. pinniger,* respectively); Cabezon (*Scorpaenichthys marmoratus*); barred surfperch (*Amphistichus argenteus*); Dungeness crab (*M. magister*); California halibut (*P. californicus)*; jacksmelt (*A. californiensis*); Pacific chub mackerel (*Trachurus symmetricus*); and Pacific sanddab (*C. sordidus*), (Table 6.3).

TABLE 6.3
PRIMARY FISH AND INVERTEBRATE TAXA RECREATIONALLY CAUGHT IN THE NEARSHORE WATERS OFF OF HUMBOLDT COUNTY (EXCEPT SHELTER COVE AND DEL NORTE): RECFIN 2013 – 2018

Fish Species		Recreational Landings (metric tons)							
Common Name	**Genus Species**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**Mean**	**% Total Catch**
Rockfish, black and yellow	*Sebastes chrysomelas*	102.17	174.79	120.69	79.43	54.82	31.43	93.89	40.52
Lingcod	*Ophiodon elongatus*	51.18	78.80	109.34	66.68	62.11	28.50	66.10	28.53
Surfperch, redtail	*Amphistichus rhodoterus*	13.70	16.73	28.22	41.09	70.55	0.12	28.40	12.26
Crab, Dungeness	*Metacarcinus magister*	44.86	NR	NR	NR	NR	NR	44.86	3.23
Cabezon	*Scorpaenichthys marmoratus*	6.07	6.95	9.82	8.07	6.56	3.86	6.89	2.97
Rockfish, vermilion	*Sebastes miniatus*	2.65	3.45	4.98	4.50	6.46	3.66	4.28	1.85
Halibut, California	*Paralichthys californicus*	0.00	NR	NR	3.31	12.42	8.50	6.06	1.74
Herring, Pacific	*Clupea pallasii*	8.05	3.39	0.68	0.34	4.51	4.59	3.59	1.55
Rockfish, copper	*Sebastes nebulosus*	2.34	1.71	2.45	3.60	6.22	3.60	3.32	1.43
Rockfish, blue	*Sebastes mystinus*	2.26	1.41	3.76	2.76	5.35	1.27	2.80	1.21
Rockfish, quillback	*Sebastes maliger*	1.92	1.64	2.61	2.42	4.22	2.14	2.49	1.08
Greenling, kelp	*Hexagrammos decagrammus*	2.19	1.58	2.77	1.21	1.42	0.93	1.68	0.73
Rockfish, canary	*Sebastes pinniger*	0.10	0.15	0.19	0.07	3.83	3.29	1.27	0.55
Seaperch, striped	*Embiotoca lateralis*	0.39	0.08	2.19	0.71	2.23	0.34	0.99	0.43
Rockfish, China	*Sebastes goodei*	1.22	0.73	0.78	0.79	0.87	0.52	0.82	0.35
Sole, Petrale	*Eopsetta jordani*	0.81	0.47	0.54	0.77	1.50	0.46	0.76	0.33
Rockfish, brown	*Sebastes auriculatus*	0.93	0.84	0.97	0.40	0.44	0.20	0.63	0.27
Sanddab, Pacific	*Citharichthys sordidus*	0.83	0.63	0.48	0.24	0.60	0.22	0.50	0.22
Rockfish, yellowtail	*Sebastes flavidus*	0.60	0.35	0.56	0.14	0.49	0.41	0.42	0.18
Topsmelt	*Atherinops affinis*	NR	NR	2.24	0.11	0.00	0.00	0.59	0.17
Jacksmelt	*Atherinopsis californiensis*	0.03	0.01	0.33	1.06	0.75	0.01	0.36	0.16

TABLE 6.3 (CONTINUED)
PRIMARY FISH AND INVERTEBRATE TAXA RECREATIONALLY CAUGHT IN THE NEARSHORE WATERS OFF OF HUMBOLDT COUNTY (EXCEPT SHELTER COVE AND DEL NORTE): RECFIN 2013 – 2018

Fish Species		Recreational Landings (metric tons)							
Common Name	**Genus Species**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**Mean**	**% Total Catch**
Rockfish genus	*Sebastes*	1.34	0.36	0.11	0.00	0.00	0.00	0.30	0.13
Rockfish, olive	*Acanthoclinus fuscus*	0.05	0.19	0.35	0.29	0.52	0.31	0.28	0.12

SOURCES:

Pacific Fishery Management Council RecFin, Humboldt County 2013 – 2018. Species shown account for 99% of mean annual recreational landings in metric tons in the Eureka area. Fished species comprising the remaining 1% include walleye surfperch *(Hyperprosopon argenteum),* tiger rockfish *(Sebastes nigrocinctus),* grass rockfish *(Sebastes rastrelliger),* leopard shark *(Triakis semifasciata),* spiny dogfish shark *(Triakis semifasciata),* red rock crab *(Cancer productus),* Pacific sardine *(Sardinops sagax),* yellow rockfish *(Sebastes ruberrimus),* silver surfperch *(Hyperprosopon ellipticum),* calico surfperch *(Amphistichus koelzi),* northern anchovy *(Engraulis mordax),* monkeyface prickleback *(Cebidichthys violaceus),* rock greenling *(Hexagrammos lagocephalus),* gopher rockfish *(Sebastes caurinus),* cancer genus *(Cancer),* flatfish order (Pleuronectiformes), shiner perch *(Cymatogaster* aggregate*),* Pacific mackerel *(Scomber japonicus),* Pacific hake *(Merluccius productus),* red Irish lord *(Hemilepidotus hemilepidotus),* widow rockfish *(Sebastes entomelas),* surf smelt *(Hypomesus pretiosus),* black rockfish *(Sebastes melanops),* Bocaccio *(Sebastes paucispinis),* surfperch family (Embiotocidae), starry flounder *(Platichthys stellatus),* Pacific staghorn sculpin *(Leptocottus armatus),* big skate *(Beringraja binoculata),* jack mackerel *(Trachurus symmetricus),* soupfin shark *(Galeorhinus galeus),* arrowtooth flounder *(Atheresthes stomias),* pile perch *(Rhacochilus vacca),* yellowtail *(Merluccius productus),* lefteye flounder family (Bothidae), bat ray *(Myliobatis californica),* rosy rockfish *(Sebastes rosaceus),* wolf eel *(Anarrhichthys ocellatus),* sand sole *(Psettichthys melanostictus),* sculpin family (Cottidae), buffalo sculpin *(Enophrys bison),* brown smooth-hound shark *(Mustelus henlei),* Dover sole *(Microstomus pacificus),* and sablefish *(Anoplopoma fimbria).*

7 Species of Special Concern

Inhabiting Northern California's coastal subtidal region are several species of special concern, which include species protected under FESA, the California Endangered Species Act (CESA), the Marine Mammal Protection Act (MMPA), the California Fish and Game Code, the National Oceanic and Atmospheric Administration (NOAA) species of concern list, the U.S. Fish and Wildlife Service, the California Department of Fish and Wildlife (CDFW), and state or federal agencies such as the California Coastal Commission (CCC) that designate species as having a scientific, recreational, ecological, or commercial importance. Table 7.1 (at the end of the section) provides a listing of all species of special concern that may be present offshore Eureka, California. Under FESA, CESA, and the MMPA, all of the marine mammals and sea turtles discussed in Section 3.3 (*Marine Mammals and Sea Turtles*) are considered species of special concern. There are FESA/CESA protected and MSA managed fish species that are considered species of special concern and are similarly discussed in Section 6 (*Fish Assemblages*) above. Finally, marine birds that are FESA, CESA, or protected under the Federal Migratory Bird Act are not part of this study, which focuses only on marine aquatic resources.

The sub-sections below discuss specific species of concern (including marine invertebrates and algae) that inhabit subtidal soft and hard substrate habitats out to approximately 1,800 m (5,906 ft) water depth offshore Eureka that may be at greater risk to fiber optic cable installations than other marine biota.

7.1 FESA/CESA Protected Invertebrate Species

7.1.1 Soft Substrate Species

Sand dollars (*D. excentricus*), as a micro-habitat forming core species, are considered by some California agencies as a species of special concern. They form dense beds in the shallow subtidal zone of open sandy beaches in water depths between 4 and 12 m (13 and 39 ft), typically just offshore of the wave zone (Merrill and Hobson 1970). As would be expected, they move locations frequently and are easily subject to physical disturbance. Most cable landings go beneath the seafloor at water depths ranging between 10 and 25 m (33 and 82 ft), connecting with the horizontal bore hole or pipeline of the onshore segment of the cable. As such, it is unlikely that sand dollar beds would be affected by fiber optic cable installations. Dense beds of sand dollars are known to occur offshore of Eureka's Samoa Beach and the entrance to Humboldt Bay (Fenstermacher *et al.* 2001). The beds offshore Samoa Beach were reported to occupy a narrow band between 8 and 15 m (25 and 50 ft) water depth, and are known to shift and move over time. The beds located offshore of the entrance to Humboldt Bay are reported to occur in slightly deeper water, between 16 and 24 m (53 and 80 ft) (Fenstermacher *et al.* 2001).

7.1.2 Hard Substrate (Sessile) Invertebrate Species

In general, hard substrate habitat occurrence offshore California, when compared to the extent of soft substrate habitat, is relatively limited. As indicated in the discussion above, the occurrence of high-relief hard substrate typically results in the presence of species that may be considered more susceptible to impacts from mechanical disturbances, such as from cable installations. The most susceptible species to these types of impacts are usually large (i.e.., more than 0.3 m [1 ft] in height), slow growing (a few to several centimeters per year), and relatively delicate/brittle or soft/friable in body form (e.g. branching corals and erect sponges), respectively. (Lissner *et al*. 1991; Hardin *et al*. 1994; Henkel *et al.* 2014; Lee 2012). For example, large erect sponges (*Demospongiae*) in a variety of colors are slow growing and, similar to the California hydrocoral (*Stylaster californica*), require several years to achieve sizes of 30 centimeters (11.8 inches) or more (e.g., Lissner *et al.* 1991; Hardin *et al.* 1994; SAIC-SLO 1999; Henkel *et al.* 2014; Lee 2012). These species are of special concern due to their natural history characteristics. Following natural or human-related disturbance, recolonization and recovery can take years due to their limited dispersal abilities and slow growth.

7.1.3 Species of Abalone, Including White Abalone (*Haliotis sorenseni*), Black Abalone (*Haliotis cracherodii*), Pink Abalone (*Haliotis corrugate*), and Green Abalone (*Haliotis fulgens*)

Abalones are large marine herbivorous gastropods that live in rocky ocean waters. White abalone is listed as endangered under FESA and occurs only in coastal waters south of Point Conception at depths of 24–30 m (80–100 ft) in low- and high-relief rock or boulder habitats interspersed with sand channels (NOAA 2015a). Black abalone also is listed as endangered under FESA; it ranges from Point Arena, California to Bahia Tortugas and Isla Guadalupe, Mexico (NOAA 2015b). Black abalone are found inhabiting rocky intertidal and very shallow subtidal habitats, typically wedged between rocks. Green abalone is listed as a species of concern (NOAA 2017a, 2017b). This species resides in shallow water on open, exposed coastal areas in the low intertidal to at least 9 m (30 ft) water depth and in some locations as deep as 18 m (60 ft). Like the white

abalone, green abalone only occur south of Point Conception. The pink abalone also is listed as a species of concern. This species occupies sheltered waters at depths between 6 and 36 m (20 and 118 ft). Pink abalone also only occur south of Point Conception.

7.1.4 Red Abalone (*Haliotis rufescens*)

Most commonly found in North Central and the southern portion of Northern California, red abalone (*Haliotis rufescens*) inhabit intertidal and shallow subtidal rocky substrate between Bahia Tortugas and Baja California to Coos Bay, Oregon. While red abalone predominantly inhabit rocky hard substrate, they are known to move across sand or gravel regions between isolated rocky substrate features. Red abalone inhabit water depths ranging between the intertidal zone to approximately 180 m (590 ft), but are most common between 6 and 40 m (20 and 131 ft) water depth (CDFG 2001).

Red abalone is a broadcast spawner that aggregates in clusters for reproduction. Young abalone, including post larva and juveniles, forage on bacteria, diatoms, and other single-celled algae (phytoplankton). Adult abalone forage on brown algae, and when food is scarce, feed on benthic diatom films.

Mortality of red abalone typically is due to predators, anthropogenic impacts, environmental conditions, and disease (CDFG 2005). Although not currently protected under federal or state endangered species regulations, red abalone support a major recreational fishery in Northern California. Recent declines in abundance and the recent closure of the fishery elevated the red abalone to a Species of Special Concern by the State of California.

All species of abalone were part of a commercial and recreational fishery offshore California until 1997, when CDFW closed the commercial fishery due to declining populations. CDFW closed the red abalone recreational fishery at the end of 2017. CDFW cited low stock abundances, starving abalone, and high mortality as reasons for the closure and is developing the Red Abalone FMP that will identify what conditions must be met in order to reopen the fishery (CDFW 2018).

7.2 Deep-Sea Corals

Deep-sea or cold-water corals are a diverse group of organisms with more than 3,000 species characterized to date across diverse environments worldwide (Smithsonian 2019). Many of these corals provide habitats for a myriad of marine species. Deep-sea corals occur primarily on hard-bottom substrate on the continental shelf and slope, in offshore canyons, and on oceanic island slopes and seamounts. Deep-sea corals are HAPCs for groundfish and other managed fish species under the Magnuson-Stevens Act.

Deep-sea coral ecosystems typically are long lived, slow growing, and fragile, which make them especially vulnerable to physical disturbances and damage. Along the west coast of North America, 101 species of corals have been identified, consisting of 18 species of stony corals, 7 species of black corals, 36 species of gorgonian or soft corals, 8 species of true soft corals, 27 species of sea pens, and 5 species of stylastid corals (Lumsden *et al.* 2007). Many of these taxa are designated as “structure-forming,” meaning they are known to provide vertical structure

above the seafloor that can be used by other invertebrates or fishes (NOAA 2010; Whitmire and Clarke 2007).

The most common stony corals observed offshore California are the solitary cup corals (e.g., *Balanophyllia elegans, Paracyathus stearsii*) and branching corals (e.g., *Lophelia pertusa, Oculina profunda, Madrepora oculata, Dendrophyllia oldroydae, Astrangia haimei, Labyrinthocyathus quaylei,* and *Coenocyathus bowersi*). Black corals, which are represented by only seven species, are considered very abundant along the Pacific coast—with *Antipathes* sp. and *Bathypathes* sp. exhibiting coast-wide distributions, while the other five species appear to be limited to seamounts (Whitmire and Clarke 2007). Gorgonians are the most populous group of corals off the Pacific coast. Purple gorgonians (*Eugorgia rubens*) and orange gorgonians (*Adelogorgia phyllostera*) are commonly observed in the nearshore coastal waters; bubblegum corals (*Paragorgia arborea*), although found in high abundance region-wide, inhabit water depths greater than 200 m. Gorgonians and black corals have branching tree-like forms and may occur as single colonies or form thickets. These three-dimensional features and vertical structures provide habitat for numerous fish and invertebrate species, and enhance the biological diversity of many deep-sea ecosystems.

Included with deep-sea corals are sea pens (order Pennatulacea), which occur over soft-bottom substrates and are the most abundant coral taxon in the region. Some sea pens are quite motile and can move from one location to another. *Stylatula* sp., *Anthoptilum grandiflorum,* and *Umbellula* sp. are the most common taxa—all of which are found coast wide. Although groves of pennatulaceans have been shown to support higher densities of some fish species over adjacent areas, they are not considered to be structure forming (Brodeur 2001).

Lace corals or stylasterid corals have been observed colonizing moderate to high-relief rocky habitats from the intertidal zone down to shelf water depths. Only five species from three genera are known to occur along the Pacific west coast, with *A. californica* being the only species known to occur in California.

A. californicus has a calcareous skeleton and forms upright pink to dark blue branching colonies. This species is characterized by very slow growth (i.e., 5 to 10 years to reach sexual maturity and possibly more than 20 years to grow to a height of 30 centimeters) (Thompson *et al*. 1993; Gotshall 1994). *Allopora* has no planktonic larval stage, and fertilization between adult colonies more than 10 m apart is rare.

In recent years, NOAA has developed an increased interest in these ecosystems and especially the potential for impacts from bottom contact fishing activities (NOAA 2014a). Deep-sea corals are being evaluated for designation as EFH within the Pacific Coast Groundfish FMP and likely will be designated once the 5-year review is complete.

Unfortunately, there is limited information concerning known occurrences of deep-sea corals offshore California. This is in part due to the difficulty and expense of locating and surveying deep-sea hard substrate habitat. Much of what the scientific community knows about their presence is a direct result of manned submersible and ROV surveys of fiber optic cable routes or oil and gas exploration sites. The extensive hard substrate rocky reefs identified occurring

offshore Eureka in 500–1,000 m (1,640–3,280 ft) can be expected to support some solitary and branching corals.

Christmas tree coral (*Antipathes dendrochristos*), a species of black coral that occurs in the Southern California Bight, has been documented around Piggy Bank and on Hidden Reef north of Santa Catalina Island; there also are a few documented occurrences around San Nicolas Island (Huff *et al.* 2013). Huff *et al.* (2013) mapped ocean currents, primary productivity (chlorophyll), and temperature against known locations of Christmas tree coral to develop a predictive model for the Southern California Bight. These environmental correlates predicted bands of low occurrence interspersed with isolated pockets of high occurrence in the Marine Study Area. Specific locations of coral within these bands and pockets depended on the availability of hard-bottom substrate. Guinotte and Davies (2014) developed a habitat suitability model for multiple species of deep-sea coral for the U.S. West Coast. They reported bands of suitable habitat associated with specific bathymetric features in the Marine Study Area. Both studies show suitable deep-sea coral habitat in places that would be crossed by the proposed cable routes. In the following specific locations, the proposed cable routes may encounter deep-sea coral:

- Bottom slopes south of the Channel Islands and around Piggy Bank;
- High-relief bottom between Santa Barbara Island and the Channel Islands; and
- High-relief bottom between San Nicolas Island and the Channel Islands.

7.3 Kelp and Sea Grasses (Submerged Aquatic Vegetation)

The giant brown kelp (*Macrocystis pyrifera*) is distributed along the eastern Pacific coast from Alaska to Mexico and again from Peru to Argentina—as well as in Australia, New Zealand, South Africa, and most sub-Antarctic islands north of 60°S (Abbot and Hollenberg 1976). They form large dense forests in the nearshore waters of Southern California and in some locations in Central California, as well as throughout the Channel Islands where clear water allows them to grow deeper than 30 m (100 ft). No known giant kelp beds occur north of Santa Cruz in nearshore waters of California.

The more dominant “forest-” forming algae in Northern California is bull kelp (*Nereocystis luetkeana*). Bull kelp is an annual that releases spores in spring that grow throughout the year and then die (Springer *et al.* 2007). Kelp forests are home to many marine animals, and act as spawning and nursery grounds for many invertebrates and fish. *Macrocystis* and *Nereocystis* anchor themselves to the seafloor by attaching their holdfasts to small boulder-sized rocks or rocky outcroppings. No known *Nereocystis* beds occur offshore Humboldt Bay or Eureka, California.

Surfgrass (*Phylospadix*) is a flowering marine plant in the family *Zosteraceae* that can be found throughout coastal California where suitable habitat occurs. It is most commonly observed attached to rocks in middle to low intertidal zones, but where conditions are favorable, it can occur to depths of 15 m. No known surfgrass beds occur in the nearshore waters adjacent to Humboldt Bay. Isolated patches of surfgrass may be present along the rock jetties flanking the entrance to Humboldt Bay.

TABLE 7.1
SPECIAL-STATUS MARINE SPECIES AND THEIR POTENTIAL TO OCCUR WITHIN THE MARINE STUDY AREA

Common Name	Scientific Name	Listing Status	Habitat, Critical Habitat	Regional Occurrence	Potential to Occur in Study Area
Marine Mammals					
Baird's beaked whale	*Berardius bairdii*	P	Inhabit deep offshore waters in the North Pacific and are common along steep underwater geologic structures, like submarine canyons, seamounts, and continental slopes.	Seasonal-sightings from late spring to early fall in California Very Rare	Not Expected. Sightings occur in deeper waters than the study area, mainly along continental shelf edges or in deep submarine canyons where they forage. National Marine Fisheries records indicate less than a dozen individuals have been washed up along the west coast of the US.
Blainville's beaked whale	*Mesoplodon densirostris*	P	Found mainly over the continental shelf and into open ocean waters. Occupy tropical to temperate waters worldwide. Groups have been regularly observed off Oahu, Hawaii and in the Bahamas in 500-1000m waters.	Rare	Not Expected. Unlikely to be observed in the study area.
Blue whale	*Balaenoptera musculus*	FE, FD, P	Blue whales are found worldwide but often occur near the edges of physical features where krill tend to concentrate. These whales begin to migrate south during November.	Seasonal from June through November in California Common	Moderate to High. Relatively common offshore the CA coast, in waters 90- 370 km from shore**.**
Bottlenose dolphin	*Tursiops truncatus*	P	Found in temperate and tropical waters around the world. Have both coastal and offshore populations. Common in areas where rivers meet the sea, and can be seen in harbors, bays, and estuaries as well as far away from the shore.	Year-round Uncommon	Not Likely. Since 2010 bottlenose dolphins have been reoccurring as far north as San Francisco. It is possible they could occur in the study area during times when waters are warmer than usual but historically, they do not occur north of central CA.
Bryde's whale	*Balaenoptera edeni*	P	Found in highly productive tropical, subtropical, and warm temperate waters worldwide. More commonly found further from shore.	Rare	Not Expected. Unlikely to be observed in the study area.

TABLE 7.1 (CONTINUED)
SPECIAL-STATUS MARINE SPECIES AND THEIR POTENTIAL TO OCCUR IN THE MARINE STUDY AREA

Common Name	Scientific Name	Listing Status	Habitat, Critical Habitat	Regional Occurrence	Potential to Occur in Study Area
Marine Mammals (continued)					
California sea lion	*Zalophus californianus*	P	Reside in the Eastern North Pacific Ocean in coastal waters. Commonly observed along the west coast of North America from southeast Alaska to the central coast of Mexico	Seasonal Common	High. Commonly observed
Common dolphin – long-beaked	*Delphinus capensis*	P	Found abundantly from Baja California northward to central California. Found in shallow, warmer temperate waters typically within 15 nautical miles of the coast and on the continental shelf.	Year-round Rare	Not Expected. The maximum northward extent is Point Arena, but numbers drop dramatically northward of central California.
Common dolphin – short-beaked	*Delphinus delphis*	P	A more pelagic species than the long-beaked common dolphin, these dolphins are associated with the California Current and can be found up to 300 nm from shore. They are commonly found near underwater geologic features where upwelling occurs.	Year-round Common	Moderate. Generally found offshore of the study area.
Cuvier's beaked whale	*Ziphius cavirostris*	P	Found in temperate, tropical, and subtropical waters. Associated in deep pelagic waters (usually greater than 1,000m deep) of the continental shelf and slope, and near underwater geologic features. Seasonality and migration patterns are unknown.	Sightings in fall and winter in California Rare	Not Expected. Generally, occur in the deeper waters west of the study area. One washed up on shore near the Mad River in March, 1957 (Houck 1958).
Dall's porpoise	*Phocoenoides dalli*	P	Distributed throughout the North Pacific Ocean and along the west coast from the US border with Mexico to the Bering Sea. Mainly found in pelagic waters deeper than 180m, but can be found both offshore and nearshore.	Sightings In winter and early spring in California Common	Low to moderate. Most frequently observed offshore, but have been seen in nearshore oceanic waters.

TABLE 7.1 (CONTINUED)
SPECIAL-STATUS MARINE SPECIES AND THEIR POTENTIAL TO OCCUR IN THE MARINE STUDY AREA

Common Name	Scientific Name	Listing Status	Habitat, Critical Habitat	Regional Occurrence	Potential to Occur in Study Area
Marine Mammals (continued)					
Dwarf sperm whale	*Kogia simus*	P	Occur over the continental slope and open ocean. Dwarf sperm whales live in tropical and temperate waters worldwide. Found in the Pacific Northwest and California, but more common near Hawaii and the Gulf of Mexico.	Rare	Not Expected. Not likely to be observed within the study area. Records of dwarf sperm whales are rare and it is unknown whether low numbers are a consequence of their cryptic behavior or if they are not regular inhabitants of offshore California waters.
False killer whale	*Pseudorca crassidens*	P	Occur over the continental slope and into open ocean waters with depths over 3,000ft of tropical and warm temperate waters worldwide.	Sightings in summer and early fall in California Rare	Not Expected. Not likely to occur in the study area because they prefer warmer waters than within the study area.
Fin whale	*Balaenoptera physalus*	FE, FD, P	Fin whales occupy the deep, offshore waters of all major oceans, but are primarily in temperature to polar waters.	Seasonal in California	Moderate. Relatively common in California waters between March and October, but due to their occurrence farther offshore in deep water, it is not likely they would be seen in the study area in high numbers.
Ginkgo-toothed whale	*Mesoplodon ginkgodens*	P	Found mainly over the continental shelf and into open ocean warm waters of the Pacific and Indian Oceans.	Rare	Not Expected. No documented sightings in the study area.
Gray whale (Western North Pacific)	*Eschrichtus robustus*	FE, FD, P	Predominantly occur within the nearshore coastal waters of the North Pacific Ocean, from Gulf of Alaska to Baja Peninsula.	Seasonal December through May in California Common	Moderate-High. Occur in coastal waters during late fall-winter southward migration and again late winter to early summer during their northward migration. Can be as close as a few hundred yards of shore, but more common 3-12 miles offshore.

TABLE 7.1 (CONTINUED)
SPECIAL-STATUS MARINE SPECIES AND THEIR POTENTIAL TO OCCUR IN THE MARINE STUDY AREA

Common Name	Scientific Name	Listing Status	Habitat, Critical Habitat	Regional Occurrence	Potential to Occur in Study Area
Marine mammals (continued)					
Guadalupe (Southern) fur seal	*Arctocephalus townsendi*	CT, FT, FD	Reside in tropical waters of Southern California and Mexico. Breed in rocky coastal habitats and caves mainly along the eastern coast of Guadalupe Island, approximately 200 Kilometers west of Baja California. There is a small population on San Miguel Island in the Channel Islands	Very Rare	Not Expected. Unlikely to occur north of Point Conception in Southern California.
Harbor porpoise	*Phocoena phocoena*	P	Continental slope to oceanic waters, mainly in northern temperate, subarctic coastal, and offshore waters. Commonly found in bays, estuaries, harbors, and fjords less than 200m deep. In California, most common north of Point Conception	Year-round in California Uncommon	Moderate. Occasionally observed in Humboldt Bay and adjacent waters. Potential to occur in the study area between 0-200 m depth.
Harbor seal	*Phoca vitulina*	P	Found as far north as British Columbia, Canada and as far south as Baja California, Mexico. Most commonly observed pinniped along California coastline. Use the offshore waters for foraging and beaches for resting. Occur on offshore rocks, on sand and mudflats in estuaries and bays, and on some isolated beaches.	Year-round in California Common	High. Common throughout the California coast. Harbor seals favor near shore coastal waters. Abundant in Humboldt Bay.
Hubb's beaked whale	*Mesoplodon carlhubbsi*	P	Endemic to the North Pacific Ocean. Species is not well known but assumed to occur mainly over the continental shelf and into open ocean waters.	Very Rare	Not Expected. May occur in waters offshore of Central and Northern California but the species is very rare.
Humpback whale	*Megaptera novaeangeliae*	FE, FD, P	Found in all major oceans. The California population of humpback whales migrates from their winter calving and mating areas off Mexico to their summer and fall feeding areas off coastal California. Humpback whales occur from late April to early December.	Seasonal – May through November in California Common	High. Frequently observed migrating along the California coast between April and November, up to 90 km offshore.

TABLE 7.1 (CONTINUED)
SPECIAL-STATUS MARINE SPECIES AND THEIR POTENTIAL TO OCCUR IN THE MARINE STUDY AREA

Common Name	Scientific Name	Listing Status	Habitat, Critical Habitat	Regional Occurrence	Potential to Occur in Study Area
Marine Mammals (continued)					
Killer whale	*Orcinus orca*	FE, FD, P	Found throughout all oceans. Most abundant in colder waters but can be somewhat abundant in temperate water. Presence and occurrence can be common but unpredictable in coastal California.	Seasonal in California Uncommon	Low. Most common during April, May, and June as they feed on northbound migrating gray whales. Generally observed in the deeper offshore waters of the study area.
Long-snouted spinner dolphin	*Stenella longirostris*	FD, P	Found in all tropical and subtropical oceans. Continental shelf to open ocean waters, but most commonly in the deep ocean where they track prey.	Sightings in summer and early fall in California Rare	Not expected to occur in the study area because they inhabit warmer waters than occur in the study area.
Minke whale	*Balaenoptera acutorostrata*	P	Distributed worldwide and can be in coastal/inshore and over the continental shelf in temperature (preferred), boreal, or polar waters.	Year-round in California Uncommon	Not Expected-Low. Minke whale sightings have occurred throughout the California coast. While rare, they could be observed within the study area.
North Pacific right whale	*Eubalaena japonica*	FE, FD, P	Found in the North Pacific Ocean. Seasonally migratory; inhabit colder waters for feeding, and then migrate to warmer waters for breeding and calving. Although they may move far out to sea during their feeding seasons, right whales give birth in coastal areas.	Rare	Not Expected. This species is the rarest of all large whale species, and fewer than 50 individuals are believed to occupy US waters.
Northern elephant seal	*Mirounga angustirostris*	P	Found from Alaska to Mexico. They are sighted regularly over shelf, shelf-break, and slope habitats and they also are present in deep ocean habitats seaward of the 2000 m isobaths. Rookeries are located in the Channel Islands, Año Nuevo State Park, near San Simeon in San Luis Obispo County, and in Point Reyes National Park.	Year-round in California Common	Moderate. Northern elephant seals are widely distributed along the west coast of North America but spend about 9 months of the year at sea.

TABLE 7.1 (CONTINUED)
SPECIAL-STATUS MARINE SPECIES AND THEIR POTENTIAL TO OCCUR IN THE MARINE STUDY AREA

Common Name	Scientific Name	Listing Status	Habitat, Critical Habitat	Regional Occurrence	Potential to Occur in Study Area
Marine Mammals (continued)					
Northern fur seal	*Callorhinus ursinus*	FD, P	Spend 300 or more days per year foraging in the open ocean of the North Pacific. Use rocky beaches for reproduction. Usually come ashore in California only when debilitated, however, a few individuals have been observed on Año Nuevo Island.	Year-round in California Common	Not Expected. Usually 18-28 km from California's shoreline.
Northern right whale dolphin	*Lissodelphis borealis*	P	Endemic to deep, cold temperate waters of the North Pacific Ocean. Also occur over the continental shelf and slope where waters are less than 66°F.	Year-round in California Common	Not Expected. Tend to occupy deep, cold waters near the continental shelf and seaward.
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	P	Occupy temperate waters of the North Pacific. Found from the continental shelf to the deep ocean.	Year-round in California Common	Low. Likely to occur throughout the California coastline but typically do not occur in nearshore waters.
Perrin's beaked whale	*Mesoplodon perrini*	P	Believed to occupy continental shelves and open ocean waters of the Pacific, but not well documented.	Very Rare	Not Expected. This whale is known from less than half a dozen strandings between San Diego and Monterey. It is highly unlikely that it will be observed within the study area, but the species' complete distribution is unknown.
Pygmy sperm whale	*Kogia breviceps*	P	Occur over the continental slope and open ocean. Prefer tropical, subtropical, and temperate waters of the Pacific Ocean. They are mostly found offshore of Peru but also occur in the waters near Hawaii and the Pacific Northwest.	Rare	Not Expected. Unlikely to occur in the nearshore waters of the study area. Strandings have been documented off Mexico, New Zealand, and Monterey Bay. Overall the species is rare and is expected to only occur south of the study area.
Risso's dolphin	*Grampus griseus*	P	Distributed throughout all major oceans. Generally found in waters greater than 1,000 m in depth and seaward of the continental shelf and slopes.	Year-round in California Common	Low. They generally occur in the deeper offshore waters of the study area.

TABLE 7.1 (CONTINUED)
SPECIAL-STATUS MARINE SPECIES AND THEIR POTENTIAL TO OCCUR IN THE MARINE STUDY AREA

Common Name	Scientific Name	Listing Status	Habitat, Critical Habitat	Regional Occurrence	Potential to Occur in Study Area
Marine mammals (continued)					
Rough-toothed dolphin	*Steno bredanensis*	P	Found in all tropical and subtropical oceans. Continental shelf to open ocean waters. Prefer the depths of tropical and warmer temperate waters.	Sighting in summer and early fall in California Rare	Not Expected. Unlikely to occur in the relatively cold waters of the study area.
Sei whale	*Balaenoptera borealis*	FE, FD, P	Wide distribution occurring in subtropical, temperature, and subpolar waters around the world. Usually observed in deeper waters of oceanic areas far from the coastline.	Seasonal – spring and summer in California Common	Not Expected. Sei whales primarily occupy the open ocean, far away from shore.
Short-finned pilot whale	*Globicephala macrorhynchus*	P	Found in warmer tropical and temperate waters. Commonly seen along the coast close to the continental shelf. Forage in areas with high densities of squid.	Year-round in California Very Rare	Not Expected. Generally found in deeper, warmer water than that which ccurs in the study area.
Southern sea otter	*Enhydra lutris nereis*	FT, P, P	A top carnivore in its coastal range and a keystone species of the nearshore coastal zone. Frequent inhabitor in kelp forests.	Year-round in Central and Southern California Common	Not Expected. Southern sea otters occupy the nearshore waters of California from San Mateo County south to Santa Barbara County. They are unlikely to be observed as far north as Eureka in Northern California.
Sperm whale	*Physeter macrocephalus*	FE, FD, P	Occur globally in the open ocean far from land and are uncommon in waters less than 300 m deep. Live at the surface of the ocean but dive deeply to catch giant squid.	Seasonal – late spring and late fall in California Common	Not Expected. Sperm whales are present offshore California year- round, peak in abundance late spring and late summer, but are rarely seen because they occupy deep offshore water.

TABLE 7.1 (CONTINUED)
SPECIAL-STATUS MARINE SPECIES AND THEIR POTENTIAL TO OCCUR IN THE MARINE STUDY AREA

Common Name	Scientific Name	Listing Status	Habitat, Critical Habitat	Regional Occurrence	Potential to Occur in Study Area
Marine mammals (continued)					
Spotted dolphin	*Stenella attenuata*	FD, P	Typically found far away from the coast in tropical and subtropical waters worldwide but can also occupy waters over the continental shelf. Spend majority of day in waters 90-300 m deep then dive to depth at night to search for prey.	Sightings in summer and early fall in California Rare	Not Expected. The eastern Pacific Ocean population typically is observed far from the coast and the population has been depleted.
Stejneger's beaked whale	*Mesoplodon stejnegeri*	P	Found in cold temperate and subarctic waters of the North Pacific Ocean. Typically occupy deep, offshore waters.	Rare	Not Expected. Typically found in deep, offshore waters on or beyond the continental shelf.
Steller (Northern) sea lion	*Eumetopias jubatus*	FE, FD, P	Distributed around the coasts along the North Pacific Ocean rim. Common in coastal waters and onshore for resting. Critical Habitat; A zone that extends approximately 1000m seaward and landward of any Steller sea lion rookery in Washington, Oregon, and California. Any aquatic foraging habitat within the species geographic range.	Seasonal in California Common	Moderate. Documented as relatively common along northern California's coast.
Striped dolphin	*Stenella coeruleoalba*	P	Continental shelf to open ocean waters worldwide, often found in areas of upwelling and around convergence zones. Prefer highly productive tropical to warm temperate waters that are oceanic and deep.	Sightings in summer and early fall in California Rare	Not Expected. Unlikely to occur near the study area. Observations are typically far offshore.

TABLE 7.1 (CONTINUED)
SPECIAL-STATUS MARINE SPECIES AND THEIR POTENTIAL TO OCCUR IN THE MARINE STUDY AREA

Common Name	Scientific Name	Listing Status	Habitat, Critical Habitat	Regional Occurrence	Potential to Occur in Study Area
Marine Turtles					
Green sea turtle	*Chelonia mydas*	FE, P	Distributed globally. Primarily use three types of habitat: oceanic beaches (for nesting), convergence zones in the open ocean, and benthic feeding grounds in coastal areas. Critical Habitat; waters surrounding Puerto Rico.	Seasonal in California Rare	Not Expected. In the eastern Pacific, green turtles have been sighted from Baja California to southern Alaska but most commonly occur from San Diego south. Northernmost sighting is offshore Marin County
Leatherback sea turtle	*Dermochelys coriacea*	FE, P	Distributed globally. Regularly seen off the western coast of the US in the pelagic with the greatest densities found off central California.	Seasonal in California Occasional	Not Expected. Leatherback sea turtles are most commonly seen between July and October, when the surface water temperature warms to 15-16° C and large jellyfish, the primary prey of the turtles, are abundant offshore. Northernmost sighting is offshore Marine County.
Olive ridley sea turtle	*Lepidochelys olivacea*	FT, P	Mainly a "pelagic" sea turtle in tropical/temperate regions of the Pacific, South Atlantic, and Indian Oceans but has been known to inhabit coastal areas, including bays and estuaries.	Seasonal in California Very Rare	Not Expected. In the eastern Pacific, the reported range of the Olive Ridley turtle extends from southern California to northern Chile. In warmer El Niño years they can be observed offshore Northern California as in 2002 in Mendocino and Humboldt Counties.
Loggerhead sea turtle	*Caretta caretta*	FE, P	Distributed throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. Occupy three different ecosystems during their lives: the terrestrial zone, the oceanic zone, and the neritic or nearshore coastal area. Critical Habitat; The Northwest Atlantic DPS critical habitat includes waters throughout the Gulf of Mexico around the Florida panhandle and up the eastern seaboard of the US.	Seasonal in California Common	Not Expected. In the Eastern Pacific, most recorded sightings are restricted to Southern California. However, sightings also are reported as far north as Oregon and Washington. No. known sightings in Northern California have been reported.

TABLE 7.1 (CONTINUED)
SPECIAL-STATUS MARINE SPECIES AND THEIR POTENTIAL TO OCCUR IN THE MARINE STUDY AREA

Common Name	Scientific Name	Listing Status	Habitat, Critical Habitat	Regional Occurrence	Potential to Occur in Study Area
Sharks and Bony Fishes					
Basking shark	*Cetorhinus maximus*	CSC, P	This species movements and migrations are poorly understood. Usually sighted from British Columbia to Baja California in the winter and spring; where they go, once they leave coastal areas, is unknown.	Seasonal in California Very Rare	Not Expected. Basking shark populations were severely depleted by commercial fisheries in the 1950s, and they have never fully recovered due to slow growth and low fecundity.
Bluefin tuna	*Thunnus thynnus*	FSC	A highly migratory species, Bluefin Tuna are distributed throughout the North Pacific. These tunas are pelagic and found in temperate and tropical oceans. They can also be found in coastal regions. They are typically in the upper 200m.	Year-round in California Common	Moderate-High. Likely to be present offshore of northern California.
Bocaccio	*Sebastes paucispinis*	FE	Bocaccio is a species of coastal rockfish found in the Pacific, from Baja California northward to the Gulf of Alaska. Most are caught in water between 75 and 230 m.	Year-round in California Common	Low-Moderate. Most abundant between Oregon and Baja California, but species is struggling to recover from overfishing.
Canary rockfish	*Sebastes pinniger*	FSC	A coastal rockfish found between Baja California and the Western Gulf of Alaska. Most common off the Oregon central coast. Tend to occupy water depths around 150m, but can be found as deep as 275m.	Year-round in California Common	Low-Moderate. The species was declared overfished in 2000, and rebuilt in 2015. Juveniles tend to stay near the water surface and adults move to deeper benthic habitats.
Chinook salmon (California coastal evolutionary significant unit)	*Oncorhynchus tshawytscha*	CE, FE, P	Live in freshwater streams up to the first two years of life, then they migrate to estuarine areas as smolts and eventually the ocean to mature and feed. These salmon prefer deeper and larger streams than those used by other Pacific species. Critical Habitat; all major rivers and coastal stretches of rivers and creeks in Sonoma, Mendocino, and Humboldt counties in California. Includes all ocean water and substrate to the full extent of the Economic Exclusion Zone.	Seasonal in California Common.	High. Present in coastal waters and larger streams and rivers throughout northern California.

TABLE 7.1 (CONTINUED)
SPECIAL-STATUS MARINE SPECIES AND THEIR POTENTIAL OCCUR IN THE MARINE STUDY AREA

Common Name	Scientific Name	Listing Status	Habitat, Critical Habitat	Regional Occurrence	Potential to Occur in Study Area
Sharks and Bony Fishes (continued)					
Chinook salmon – spring run (Klamath-Trinity Rivers population)	*Oncorhynchus tshawytscha*	FE	Upper Klamath-Trinity Rivers and coastal waters in northern California. Critical Habitat; all major rivers and coastal stretches of rivers and creeks in Humboldt, Del Norte, Trinity, and northern California counties. Includes all ocean water and substrate to the full extent of the Economic Exclusion Zone.	Seasonal in California Common	High. This population is endemic to the Klamath-Trinity Rivers.
Chum salmon	*Oncorhynchus keta*	CE	Chum salmon are the most widely distributed of all the salmon species found in the Pacific. They inhabit waters throughout the North Pacific Ocean to the coastal regions of North American and Asia.	Common	Low. The status of Chum salmon in California is poorly understood, and it is believed that their numbers are too small to be detected.
Cowcod	*Sebastes levis*	CSC, FCS, P	Found from central Oregon to Baja California, Mexico. Juveniles recruit to fine sediment habitat. They have been observed at depths between 40 and 100 m. Young cowcod move to deeper habitat within their first year.	Seasonal in California Common	Moderate. Documented catch has declined drastically since the mid 1980s. May be present near seafloor.
Coho salmon (Northern California population)	*Oncorhynchus kisutch*	FE, CE, P	Spawn in small streams with gravel substrates, and spend first half of life cycle in streams and small freshwater tributaries. The later-half of life cycle is spent foraging in estuarine and marine waters.	Seasonal in California Common	High. Coho salmon inhabit the Big Lagoon, just north of Eureka.

TABLE 7.1 (CONTINUED)
SPECIAL-STATUS MARINE SPECIES AND THEIR POTENTIAL OCCUR IN THE MARINE STUDY AREA

Common Name	Scientific Name	Listing Status	Habitat, Critical Habitat	Regional Occurrence	Potential to Occur in Study Area
Sharks and Bony Fishes (continued)					
Longfin smelt	*Spirinchus thaleichthys*	CT	Found along the Pacific coast from Alaska to California. Adults live primarily in bays, estuaries, and nearshore coastal areas, migrating to low salinity or freshwater reaches to spawn. Spawning occurs primarily in January to March.	Seasonal in California Common	Moderate. Humboldt Bay ranks second in Longfin smelt abundance after the Sacramento-San Joaquin Delta/San Francisco Bay Estuary. Seasonally absent from marine waters as spawning occurs in freshwater, typically January - March
North American green sturgeon (northern distinct population segment)	*Acipenser medirostris*	CSC, FSC	The northern distinct population segment of green sturgeon are those that spawn from the Eel River northward to the Klamath and Rogue Rivers. Critical Habitat; All ocean water out to 60 fathoms depth from Monterey Bay northward to the border with Canada.	Common	Low. There a very few data on green sturgeon presence in coastal waters. This species may forage in or near the marine study area but its distribution in ocean waters is essentially unknown.
Pacific Ocean perch	*Sebastes alutus*	FSC	Distributed from the Western Aleutian Islands in Alaska to throughout California, although they become increasing rare moving south through California.	Common	Low-Moderate. Adults and juveniles appear to inhabit water depths ranging between 150 420 meters.

TABLE 7.1 (CONTINUED)
SPECIAL-STATUS MARINE SPECIES AND THEIR POTENTIAL OCCUR IN THE MARINE STUDY AREA

Common Name	Scientific Name	Listing Status	Habitat, Critical Habitat	Regional Occurrence	Potential to Occur in Study Area
Sharks and Bony Fishes (continued)					
Pink salmon	*Oncorhynchus gorbuscha*	CE	Pink salmon are distributed on both sides of the North Pacific Ocean. They are the most abundant of the Pacific salmon and are common from Alaska through Washington, but also are known to occur in Northern California. Pink salmon spawn in freshwater streams and rivers but do not spend extended periods of time in freshwater. Instead they migrate out to the ocean to feed and grow.	Common	Low. More common in Washington and Alaska.
Steelhead trout (Northern California distinct population segment)	*Onchorhynchus mykiss irideus*	FT, CSC, P	Can be found along the entire Pacific Coast of northern California. Anadromous individuals can spend up to 7 years in fresh water prior to smoltification, and then spend up to 3 years in salt water prior to first spawning. Individuals that spend their entire life in fresh water are called rainbow trout. Critical Habitat; Essentially all major rivers and coastal stretches of all rivers and creeks throughout California,	Seasonal in California Common	Moderate. Spawn in streams and rivers throughout northern California. Adults may occur in coastal waters near streams and rivers.
Steelhead trout (Klamath Mountains)	Onchorhynchus mykiss irideus	FSC, P	Same as the Northern California DPS, but endemic to the rivers associated with the Klamath Mountains.	Year-round in California Common	Moderate. Spawn in streams and rivers of the Klamath Mountains. Adults may occur in the coast waters associated with these freshwater systems.

TABLE 7.1 (CONTINUED)
SPECIAL-STATUS MARINE SPECIES AND THEIR POTENTIAL OCCUR IN THE MARINE STUDY AREA

Common Name	Scientific Name	Listing Status	Habitat, Critical Habitat	Regional Occurrence	Potential to Occur in Study Area
Sharks and Bony Fishes (continued)					
Swordfish	Xiphias gladius	FSC	Distributed throughout the world's oceans, mostly in tropical and temperate waters, but they also have been documented in cold waters of major oceans. They are found along the eastern edge of the North Pacific Ocean.	Common	Low. Swordfish are mostly found in offshore waters and farther to the south than the Study Area.
Tidewater goby	Eucycloglobius newberryi	CSC, FE, P	Despite the common name, this goby inhabits lagoons formed by streams running into the sea. The lagoons are blocked from the Pacific Ocean by sandbars, admitting salt water only during particular seasons, and so their water is brackish and cool. The tidewater goby prefers salinities of less than 10 parts per thousand (ppt) (less than a third of the salinity found in the ocean) and is thus more often found in the upper parts of the lagoons, near their inflow. Critical Habitat: The Big Lagoon in Humboldt County is designated as critical habitat for the tidewater goby.	Seasonal in California Common	Not Expected. Although Big Lagoon is recognized as critical habitat for the Tidewater Goby, the species spends its entire life within estuaries and tidal lagoons. Not expected to be present in the Study Area.
White sharks	*Carcharodon carcharias*	CSC, P	Coastal and offshore waters along the continental shelf and islands. In California, important white shark habitat occurs around Monterey Bay and Greater Farallon's national marine sanctuaries. White shark populations are impacted by purposeful and incidental capture by fisheries, marine pollution, and coastal habitat degradation	Year-round in California Common	High. Present in coastal waters throughout the State.

TABLE 7.1 (CONTINUED)
SPECIAL-STATUS MARINE SPECIES AND THEIR POTENTIAL OCCUR IN THE MARINE STUDY AREA

Common Name	Scientific Name	Listing Status	Habitat, Critical Habitat	Regional Occurrence	Potential to Occur in Study Area
Sharks and Bony Fishes (continued)					
Widow rockfish	*Sebastes entomelas*	FSC	A coastal rockfish found between the north end of Baja California and the Gulf of Alaska. Most common between British Columbia and northern California. Most commonly found between approximately 130-230m depth	Year-round in California Common	Low. Not regularly seen in California. Adults of the same size class tend to move seasonally between adjacent areas.
Yelloweye rockfish	*Sebastes ruberrimus*	FSC	Distributed throughout Alaska and the West Coast of the U.S. Primarily inhabit high-relief rocky habitats in depths ranging between approximately 20-375m.	Year-round in California Common	Low. The rebuilding of their numbers from overfishing requires decades.
Gastropods					
Black abalone	*Haliotis cracherodii*	FE, P	Coastal and offshore island intertidal habitats on exposed rocky shores where bedrock provides deep, protective crevices for shelter. Range from Point Arena, California to Bahia Tortugas and Isla Guadalupe, Mexico. Very Rare in northern California Critical Habitat; essentially all of the California coast.	Year-round in California Very Rare	Not Expected. They are rare north of San Francisco and Point Arena is considered the northward most extent of the species.
Green abalone	*Haliotis fulgens*	FSC, P	Coastal and offshore island intertidal habitats on exposed rocky shores where bedrock provides deep, protective crevices for shelter. Green abalone habitat ranges from Point Conception, California to Bahia Magdalena, Baja California Sur, Mexico.	Year-round in California Very Rare	Not Expected. Green abalone are not likely to occur north of Point Conception, California.

TABLE 7.1 (CONTINUED)
SPECIAL-STATUS MARINE SPECIES AND THEIR POTENTIAL OCCUR IN THE MARINE STUDY AREA

Common Name	Scientific Name	Listing Status	Habitat, Critical Habitat	Regional Occurrence	Potential to Occur in Study Area
Gastropods (continued)					
Pink abalone	*Haliotis corrugate*	FSC, P	Coastal and offshore island intertidal habitats on exposed rocky shores where bedrock provides deep, protective crevices for shelter. Distributed from Point Conception to Bahia de Santa Maria in Baja California, Mexico.	Year-round in California Very Rare	Not Expected. Pink abalone are unlikely to be found north of the Southern California Bight.
White abalone	*Haliotis sorenseni*	FE, P	Coastal and offshore island intertidal habitats on exposed rocky shores where bedrock provides deep, protective crevices for shelter. Range from Point Conception, California to Punta Abreojos, Baja California, Mexico.	Year-round in California Very Rare	Not Expected. White abalone are not likely to occur north of Point Conception, California.

NOTES:

FESA = federal Endangered Species Act

MMPA = Marine Mammal Protection Act

CESA = California Endangered Species Act

POTENTIAL FOR SPECIES OCCURRENCE RANKINGS:

Not Expected – Suitable foraging or spawning habitat is not known to be present or rare, and the species has not been or is rarely documented to occur

Low – Suitable foraging or spawning habitat is present, but the species has either not been documented to be present or if present, the presence is uncommon and infrequent

Moderate – Suitable foraging or spawning habitat is present, and the species is somewhat common or common for part of the year

High – Suitable foraging or spawning habitat is present, and the species is common throughout the year and/or in substantial numbers

TABLE 7.1 (CONTINUED)
SPECIAL-STATUS MARINE SPECIES AND THEIR POTENTIAL OCCUR IN THE MARINE STUDY AREA

STATUS CODES:

Federal: National Oceanographic and Atmospheric Administration (NOAA); MMPA

FD = Depleted Population

P = Federally Protected

Federal: U.S. Fish and Wildlife Service (USFWS), NOAA National Marine Fisheries Service (NMFS); FESA

FDL = Delisted

FE = Listed as "endangered" (in danger of extinction) under FESA

FT = Listed as "threatened" (likely to become endangered within the foreseeable future) under FESA

FC = Candidate to become a proposed species

FSC = Former "federal species of concern". The USFWS no longer lists Species of Concern but recommends that species considered to be at potential risk by a number of organizations and agencies be addressed during project environmental review. *NMFS still lists "Species of Concern".

State: California Department of Fish and Game (CDFG); CESA

CE = Listed as "endangered" under CESA

CT = Listed as "threatened" under CESA

CSC = CDFW designated "species of special concern"

SOURCES:

Allen 2014; Allen et al. 2010; AMS 2015; CDFW 2009, 2012, 2018,b; Dick et al. 2009; Driscoll 2014; Houck 1958; Love and Yoklavich 2008; Marine Mammal Commission Marine Mammal Species of Special Concern 2018; Miller and Shanks 2004; NOAA 2011, 2014b, 2018a, 2019a, 2019b, 2019c, 2019d, 2019e, 2020; Prado 2016; Kimmey 2015; Whaleopedia 2019.

8 Potential Effects of Fiber Optic Cable Installation and Operation on Intertidal and Subtidal Marine Communities

The installation, maintenance, and ultimate abandonment/removal of a subsea fiber optic cable located in the coastal waters of California can be expected to result in disturbances to the communities that the cable traverses. These impacts likely would vary, not only with respect to the route and substrate type but also according to installation methods that will depend on water depth and substrate type. In shallow water soft-sediment areas, divers or ROVs typically bury the cable using a water jet to create a channel into which the cable is laid. Typically, the cable channel is allowed to self-bury. In deeper soft-bottom areas, a cable installation plow is used to dig a 1-m (3.3-ft) deep trench in the seafloor, place the cable into the trench, and then refill the trench with the excavated sediment.

In the event that a proposed cable route contains hard substrate features, the final routing of the cable will avoid, to the maximum extent feasible, moderate- and high-relief outcrops, especially in high-energy environments in water depths less than 33 m (100 ft). If placement along mixed-bottom or low- to moderate-relief habitat is unavoidable, the cable typically is laid onto the seafloor; and an ROV or divers are used to properly position the cable around isolated exposed outcrops or high-relief features, and to locate the cable so that minimum contact with more sensitive hard-bottom habitat occurs.

In addition to direct physical disturbance of marine habitats by cable placement or burial during installation, other potential effects include:

- Short-term and isolated increased water turbidity during cable burial in soft seafloor sediments with a cable plow or by ROV or diver trenching activities;
- Potential release of drilling fluids during the boring of the fiber optic cable landfall conduits;
- Underwater noise from marine construction work vessels and cable-laying activities; and
- Accidental release of hydrocarbon-containing fuel oils and lubricants by work vessels engaged in cable installation and landfall conduit horizontal directional drilling (HDD) activities.

Numerous fiber optic cables have been installed in the coastal waters of California, Oregon, and Washington over the past several decades (SAIC-SLO 1999; SAIC 1999; SAIC 2000; MBC 2001; MBARI 2004; AMS 2008, 2016a, 1999b). Within California, landfalls have occurred in Southern California (San Diego, Hermosa Beach, Manhattan Beach, Los Angeles, and Santa Barbara), Central California (Montana del Oro, Grover Beach, Estero Bay, and Moss Landing), and Northern California (Manchester Beach). CEQA and NEPA documents prepared for these projects discuss in detail the potential impacts on marine biota from installation, operation and removal/abandonment of fiber

optic cables. Mitigation measures outlined in these documents can be assessed for their efficacy in preventing or minimizing the potential effects on marine resources. Additionally, pre- and post-cable lay ROV surveys have been performed that provide information on the longevity and severity of potential effects on marine habitats and biota. Finally, the effects of cable installation and operation on marine soft and hard substrate habitats and associated biological communities have been assessed in a number of diverse locations, including the Olympic Coast National Marine Sanctuary, Washington (NOAA 2018b); Monterey Bay, California (Kogan *et al.* 2006, Kunz *et al.* 2015); coastal waters in Australia (Sherwood *et al.* 2016); and multiple other locations worldwide (Kraus and Carter 2018).

Potential effects undoubtedly will vary between each project depending on project specifics, route, location along the coast, and technical approach for installation. The following discussion provides a brief synopsis of potential marine effects on marine biological resources from fiber optic cable installation and operation, and outlines operational actions that can be implemented to prevent significant impacts on marine ecosystems.

8.1 Soft-Bottom Habitat and Associated Biota

Impacts on soft-sediment biota during cable installation, operation, or abandonment can be expected to be short term and therefore temporary (Kraus and Carter 2018; Antrim *et al*. 2018; Kunhz *et al.* 2015; Kogan *et al.* 2006). The use of a cable plow to create a furrow along the seafloor into which the fiber optic cable is placed and buried can be expected to result in a temporary disturbance of benthic infauna (animals living in the sediments of the seafloor) and epifauna (animals living on the surface of the seafloor). It is estimated that the actual area of disturbance is less than 8 m (26 ft) wide, with the most severe effects being limited to the 1-m- (3.3-ft-) wide trench made by the plow (Kraus and Carter 2018). Many motile epifaunal invertebrates and fishes can be expected to avoid the plow and return to the area shortly after the plow has left and the trench has been refilled. Any benthic infauna inhabiting the upper sediment layers disturbed by the plow are assumed to be smothered and killed. This loss, however, will occur in a small area of the seafloor relative to the surrounding area. The infaunal community inhabiting the adjacent, undisturbed sediments are expected to rapidly start recolonizing the affected area. Recolonization will occur both by migration from adjoining, undisturbed seafloor areas and by natural recruitment (Kunhz *et al.* 2015; Kraus and Carter 2018; Antrim 2018; Kogan *et al.* 2006).

Studies of the ATOC/Pioneer seamount cable (Kogan *et al.* 2006), the PAC fiber optic cable in the Olympic Coast National Marine Sanctuary (Antrim *et al.* 2018), the MARS fiber optic cable in the Monterey Bay National Marine Sanctuary (Kunhz *et al.*. 2015), and other submarine cables worldwide (Kraus and Carter 2018) found that recolonization of soft sediment communities was fairly rapid, beginning within weeks of the disturbance; but full recovery of the community could take up to a couple of years. Key factors in the recovery of seafloor sediments were water depth, sediment composition, level of energy present, and whether the location was depositional or erosional. Studies that specifically investigated benthic infaunal and epifaunal communities along the cable

routes found no significant differences in community composition between studied sites adjacent to the installed cables and comparison sites several hundred meters distant from the cables (Kogan *et al.* 2006; Kunhz *et al.* 2015; Antrim *et al.* 2018). A similar study on a high-voltage direct current power cable installation offshore Australia concluded that the ecological effects of the cable installation on soft substrate epibiota were transient and minor (Sherwood *et al.* 2016).

These findings are similar to findings from studies of offshore sand mining operations in the Gulf of Mexico and in the Atlantic Ocean, where large areas of sand are removed for shoreline restoration. These studies have shown that recovery of the benthic infaunal and epifaunal community to comparable pre-disturbance conditions typically occurs within a couple of years following the disturbance (Hammer *et al.* 1993; Van Dolah *et al*. 1992). The key factors influencing the speed of recovery in these studies were (1) when the impact occurred relative to seasonal periods of spawning and recruitment; and (2) the proximity of undisturbed sediment to the disturbed/affected area.

Because the disturbance to benthic infauna during the proposed cable installation offshore Eureka, California does not involve permanent sediment removal, and the distance between disturbed and undisturbed sediment typically will be less than 0.5 m, recovery to pre-disturbance conditions is expected to be relatively rapid, requiring a couple of years or less for full recovery.

Disturbances resulting from laying cable in shallow water areas with coarse sand can be similar to disturbances in deeper areas covered with fine sediments, despite the existence of different types of sediments. Similar levels of disturbance also may result even if different methods of cable burial are used, such as ROVs or cable plows. In the very nearshore areas, in water depths less than 30.5 m (100 ft), the seafloor and associated biota experience frequent and regular disturbances from wave action. As a result of this high-energy, constantly changing environment, the associated biological community has adapted to frequent exposure and burial. The infaunal community typically is limited in species diversity and consists primarily of filter feeders (e.g., tube worms, sand dollars, sand anemones) and detrital feeders (e.g., shrimp and crabs). These taxa also tend to be highly mobile; consequently, any effects on the habitat and associated biota can be expected to be undetectable within a few days or months of cable installation.

During cable plowing and trenching activities, temporary spikes in near-seafloor turbidity may occur. Increased turbidity typically is restricted to the water immediately above and adjacent to the seafloor where the plowing or trenching occurs. Depending on water depth and natural wave and current energy, turbidity plumes (i.e., resuspended sediments) generated from the trenching can be expected to resettle to the seafloor quickly. During ROV surveys of cable routes, seafloor sediments frequently are disturbed by the ROV thrusters and generate turbidity plumes similar to those generated by cable plows (AMS 2008, 2016a). These turbidity plumes also quickly dissipate within minutes following the disturbance.

Similar to increases in turbidity from cable trenching and plowing activities, HDD boring of conduits can result in turbidity increases through the accidental release of bentonite

drilling fluid to the seafloor and nearshore subtidal habitats. Bentonite is a marine clay that is used for lubricating the borehead cutting tool and transporting borehole cuttings back to shore. The HDD boring process typically terminates the landfall conduit installation at water depths between 12 and 17 m (40 and 55 ft). In general, the offshore termination point along the cable route is selected to occur in soft sediment habitat. Throughout most of California, the seafloor sediments occurring at these water depths are composed of sand with some minor silt and clay components. Coastal seafloor sediments at these water depths also typically are exposed to wind and wave surge, as well as regular resuspension of seafloor sediments, resulting in naturally occurring increased turbidity near the seafloor.

The accidental release of small volumes of bentonite drilling fluid into this environment is not expected to result in any detectable effects on marine biota above that which may be naturally occurring in the area of release, or to result in any permanent changes to soft substrate habitat. Any released bentonite clay would be expected to be quickly resuspended by wind- and wave-generated surge present at these shallow water depths and to be transported with similar sized sediment particles to natural depositional areas along the coast. Any potential increased turbidity resulting from the accidental release of bentonite drilling fluid would be expected to be either non-detectable against existing background turbidity conditions at the release site or to be quickly dissipated similar to any increased turbidity caused by cable trenching or plowing.

The greatest potential for substantive effects on marine habitats and associated marine biota from the accidental release of bentonite drilling fluids during HDD boring activities is release of a large volume of fluid. Such a large release could result in short-term smothering and burial of benthic epifauna and infauna, as well as clogging of fish gills (Robertson-Bryan 2006). It also could cause longer term increased turbidity in the area of the release. Early detection of any accidental release of bentonite drilling fluid, and the immediate cessation of HDD drilling activities until operational steps can be taken to stop the release of drilling fluid, are key to limiting the potential effects on marine habitats and biological resources. Preparation and implementation of an HDD monitoring plan that details procedures for preventing the accidental release of drilling fluid during HDD work, as well as operational and release response procedures in case of a drilling fluid release, can prevent the inadvertent discharge of large volumes of bentonite drilling fluid to the marine environment.

A key and critical component of an HDD monitoring plan is inclusion of rhodamine dye into the drilling fluid, paired with on-site monitoring, to detect its presence in the ocean waters along and adjacent to the HDD borehole route during active boring activities. Since 2000, bentonite drilling fluid has been detected infrequently among a total of 32 coastal fiber optic cable landing projects using HDD boring technology (AMS 2001, 2002a, 2002b, 2003, 2016b, 2018). In only a few cases was drilling fluid documented being discharged to the marine environment. In each of these occurrences, the boreholes were suspected of being drilled through naturally fractured and faulted geologic layers, such as the Monterey formation, where the drilling fluid could travel through existing fractures in buried substrates to the seafloor surface (AMS 2002a). In some cases, the observation of discharged drilling fluids to the seafloor was just prior to the borehole

exiting the seafloor, and immediate substitution of water for the drilling fluid curtailed any further discharge of drilling fluid (AMS 2002a). Placement of rhodamine dye into the drilling fluid for these cable landing projects permitted early detection of the potential for or the occurrence of discharged drilling fluid to the marine environment. This early detection of rhodamine dye enabled immediate cessation of HDD boring activities and implementation of alternative boring procedures that either stopped the release of drilling materials to the marine environment or minimized the potential effect of discharged materials to the marine environment (AMS 2001, 2002a, 2002b, 2003, 2016b, 2018).

Use and operation of marine construction equipment and vessels always poses some risk of an accidental release of hydrocarbon-based products such as fuel oil, diesel fuel, lubricants, and hydraulic fluids. Depending on the quantity released, the accidental release of these products into the marine environment has the potential to affect marine habitats and taxa. These impacts could come from oiling; destruction or degradation of habitat, food sources, or nursery grounds; or chronic toxicity.

Vessels operate under strict state and federal regulatory requirements that include measures to prevent and respond to an unforeseen accidental release of hydrocarbon-based products. These vessel-specific spill prevention and response plans include procedures to prevent, contain, report, recover, and remove any accidentally released hydrocarbon materials onboard the vessel or from the vessel into the ocean. Additionally, project-specific spill prevention and response plans include specific requirements that prevent hydrocarbon products present at work sites and onboard work vessels from reaching coastal waters. Such spill plans typically will prevent stockpiling of hydrocarbon-based products onboard, include onsite recovery and clean-up procedures for equipment and materials, and include training requirements for project personnel. These types of requirements routinely prevent the occurrence of accidental releases as well as minimize the potential exposure to marine ecosystems.

8.2 Hard Substrate Habitat

Impacts from cable installation potentially can be most severe in hard substrate habitat that occurs within the cable route. The biota associated with hard substrate habitat is predominantly sessile, slow growing, and susceptible to crushing, dislodgement, and other physical disturbances. High-relief hard substrate areas (> 1 m [3.3 ft]) generally are considered to be more sensitive to impacts than low-relief hard-bottom habitat (< 1 m [3.3 ft])(Lissner *et al*. 1991). This is because of their higher species diversity, species abundances, and the potential presence of organisms that are sensitive to physical disturbances such as erect turf species, hard and soft hydrocorals, and branching and erect sponges (Lissner *et al*. 1991). Mixed-bottom and low-relief hard-bottom habitats generally have lower species diversity and abundances due to frequent cycles of burial by sand and higher turbidity near the seafloor. These harsher physical conditions typically result in a more ephemeral biological community that is often dominated by organisms that are more tolerant of high turbidity and sand scouring, or are able to grow fast enough to avoid complete burial. Typical taxa observed in recent ROV habitat and macrobenthic taxa surveys for fiber optic cable routes in California include cup corals, gorgonian

corals, brittle stars, sea stars, puffball and other similar encrusting sponges, and some species of anemones such as *Stomphia* and *Urticina*.

The predominant species inhabiting moderate- to high-relief hard substrate in water depths <200 m (650 ft) include turf communities (mixtures of small hydroids, bryozoans, tunicates, and sponges), cup corals (*Paracyathus* and *Balanophyllia*), sea stars (*Asterina* and *Henricia*), brittle stars (*Amphipholis*), red algae (at depths to about 30 m), rockfishes (*Sebastes* spp.*)*, lingcod (*O. elongatus*), and painted greenling (*O. pictus*). Additionally, on hard-bottom moderate- to high-relief features in water depths >100 meters (300 ft), the feather star or crinoid (*Florometra serratissima*) and the large plumose anemone *Metridium* frequently are observed. All of these taxa are capable of withstanding periodic physical impacts. Other species, such as California hydrocoral (*S. californica*), branching coral (*Lophelia*), colonial anemone (*C. californica*), and large erect sponges, typically are more sensitive to physical impact/burial and may require longer periods to recover. *Metridium* and *Corynactis* are common species on moderate- and high-relief substrate, whereas observations of *Stylaster and Lophelia* are reported infrequently in past cable route surveys.

The potential for post-lay disturbance effects is highly dependent on where the cable is located within a hard substrate area, the type of hard substrate present (i.e., mixed, low, moderate or high relief), and how securely the cable is installed on the seafloor. Suspensions often result in continued movement of the cable in response to currents and wave action in shallow depths (< 30.5 m [100 ft]), causing abrasion of hard substrate (Kogan *et al.* 2006; Kuhnz *et al.* 2015). Based on observations made during past cable route and post-lay surveys in California coastal waters, the impacts on associated biota from post-lay movement appear to be minimal with careful placement of the cable. During a survey of the AT&T Asia-America Gateway (AAG) S-5 cable near Morro Bay, California, AMS (2008) reported that they could not detect any noticeable impacts associated with previously laid cables in the area. Several studies have reported the presence of large erect sponges, *M. farcimen* anemones, and other sessile organisms growing on or over exposed cables (SAIC 1999; Kogan *et al.* 2006; Kuhnz *et al.* 2015). An ROV survey of the MCI-ATT fiber optic cable route offshore Montaña del Oro reported small, localized movements of a previously installed trans-pacific telephone cable (up to 10 centimeters [4 inches] in width) occurring when the cable was laid over hard substrate habitat in a high wave energy, shallow-water location (SAIC-SLO 1999). Similarly, sections of the surface-installed ATOC/Pioneer Seamount cable running through soft silt/sandstone offshore Pigeon Point, California reported deep groves cut into exposed rock from cable strumming in very high-energy, shallow-water depth (<11 m [35 ft]) (Kogan *et al.* 2006). The installation of a power transmission cable through a glass reef located offshore British Columbia resulted in 100% mortality of glass sponges immediately under the cable and up to 15% within 1.5 m (4.5 ft) of the cable, because of the method of installation (Dunham *et al.* 2015). No evidence of cable movement was observed, however, once the cable was installed.

Recovery of disturbed hard substrate areas by immigration, asexual propagation, or larval recruitment should begin occurring within months of the disturbance. However, some areas take longer to recover fully than others. A study performed in the Pt. Arguello area

suggested that the small areas of hard-bottom habitat that might be disturbed by cable-laying operations could take years to recover fully to pre-disturbance conditions (Hardin *et al.* 1993). These authors reported estimated mean time for recovery to background densities of 23 years for *Paracyathus stearnsi* and 19 years for *Lophogorgia chilensis* in areas disturbed by dragging anchors during pipe-laying operations. In his assessment of the ecological effects of a power cable installation offshore Australia, Sherwood *et al.* (2016) reported that the armored cable running over hard substrate provided a colonizable surface for reef species comparable to species found in surrounding coral reefs within 3.5 years of installation. Dunham *et al.* (2015), reported that the glass sponge reef offshore British Columbia had recovered to approximately 85% natural reef growth and cover when compared to control sites within 2-years of the cable's installation. Finally, during the assessment of the ATOC/Pioneer cable, the surface-laid cable through soft sediment areas of the cable route was noted to provide artificial hard substrate habitat that was quickly colonized by *M. farcimen* and *Urticina* spp. anemones, occasional sponges, and other low-relief colonizing taxa (Kogan *et al.* 2006). In this latter case, species diversity and abundance associated with the cable actually were higher than that of adjacent sediment habitats (Kogan *et al.* 2006). These authors further noted that the presence of the attached epifaunal community established a microcosm that attracted fish and crab taxa (Kogan *et al.* 2006).

Increased turbidity from cable trenching or plowing activities, or the accidental release of bentonite drilling fluid, can be expected to pose a greater negative effect on hard-bottom habitats compared to soft-bottom habitats. As discussed above, marine taxa, such as colonial and branching corals, large erect sponges, anemones, hydrocorals—and in shallower waters, brown, red, and green algae—generally are more sensitive to increased turbidity and sediment deposition than solitary cup corals and turf species. Project-induced turbidity, sedimentation, and bentonite drilling fluid releases can result in increased burial of low-, moderate-, and high-relief hard substrate and attached taxa, clogging of fish gills and feeding surfaces, and temporary loss of foraging habitat. These impacts can be expected to be greater for moderate- to high-relief habitat and associated biota because of their greater sensitivity to sedimentation and the longer time it takes to recover from impacts (Hardin *et al.* 1993). Terminating cable trenching and HDD borehole cable conduits in areas of soft sediment that are away from hard-bottom habitat and associated biota, as well as development and implementation of an HDD monitoring plan, can be expected to prevent and minimize potential exposure of hard substrate habitat and biota to accidental bentonite drilling fluid releases and increased turbidity from cable trenching and burial.

Potential exposure of hard substrate habitat and associated marine communities, including fishes, marine mammals, and sea turtles, to hydrocarbon materials typically is worse than that posed for soft substrate communities because of the time it takes these communities to establish themselves. As for soft substrate communities, implementation of spill prevention, training, and response procedures can be expected to prevent the occurrence of accidental hydrocarbon releases or limit the volume of released material.

8.3 Fishes

Most of the environmental assessments prepared for underwater fiber optic cables (e.g., CSLC 2000a, 2000b, 2005, 2019) indicate that temporary displacement of some fishes from the immediate vicinity (e.g., tens of feet) of the cable route would occur during passage of cable installation equipment. The impacts described in these assessments are considered temporary (i.e., on the order of hours) and localized (occurring over a limited area), and therefore less than significant. Extensive alteration or destruction of habitat or communities lasting more than 1 year is unlikely due to the small size of the cable, the localized corridor represented by the route, and burial of the cable along most of the inshore route to a depth of 100 fathoms (185 m [600 ft]) of the route. Bottom communities disturbed by cable installations are expected to return to pre-installation conditions in a relatively short amount of time (less than 1 year), which typically is documented by a post-installation survey.

Fishes could be exposed to temporary and isolated increased underwater noise from cable-laying activities and from work vessels involved in HDD boring and cable installation activities. Exposure to elevated sound levels can lead to short-term hearing loss in fishes, known as a temporary threshold shift (TTS), or irreversible injury, referred to as a permanent threshold shift (PTS) (CalTrans 2015; McCauley *et al.* 2003). Loud noises also can cause other physiological damage such as swim bladder rupture or even death (CalTrans 2001, 2015; Hastings and Popper 2005). Many factors, such as the duration of the sound, proximity to the source, and life history characteristics, can determine the extent of the damage (Hastings and Popper 2005).

Studies in the North Sea assessing cable trenching and plowing projects for offshore wind farms reported peak underwater noise levels of 178 dB re 1 µPa at a distance of 1 m (3.3 ft) (Nedwell *et al.* 2003). Similarly, peak underwater noise levels, defined as the maximum variation in the pressure wave from positive to negative for cable-laying ships, have been reported to range between 170-180 dB re 1 µPa at a distance of 1 m (3.3 feet) (Hale 2018) and 160-180 dB at a distance of 1 m for small work boats (Bailey *et al.* 2010; CalTrans 2015). Peak nearshore background underwater noise levels have been reported averaging between 128 and 138 dB re 1 µPa at a distance of 1 m (3.3 feet) (Fabre and Wilson 1997). Therefore, generation of underwater noise by fiber optic cable installation most likely is below established acute impact levels of 183 dB and 187 dB for fishes less than and greater than 2 grams in mass, respectively, and only slightly higher than the 150-dB level established for behavioral disturbance (CalTrans 2015). Additionally, it is anticipated that project-generated underwater noise levels will drop below behavioral sound criteria for fish in approximately 32-64 m (95-210 ft), and be below background underwater noise levels in 128-160 m (420-840 ft) from the source, based on an assumed drop of 5-6 dB per doubling of distance from the noise source (McKenna *et al.* 2012). Given the low magnitude of underwater noise generated by most cable-laying activities relative to established thresholds for acute effects on fish, and the short duration over which cable-laying activities will exceed background noise conditions, no substantive effects on fish are anticipated.

As discussed above for invertebrate taxa, the accidental release of hydrocarbon-based products has the potential to affect any fishes that happen to be present in the area affected by the release. Preparation and implementation of a spill prevention, training, and response procedures plan can be expected to prevent the occurrence of accidental hydrocarbon releases from cable installation and maintenance activities, as well as limit the volume of any released material and therein the potential effects on fish taxa, should it occur.

8.4 Marine Mammals and Sea Turtles

No significant effects on marine mammals are anticipated from cable installation at the landing sites or along the offshore route. Many of the potential impacts such as disruption of migration routes or increased noise during installation are considered temporary, lasting only hours (along the sea route installation) to a few days (at the cable landfall location) in any one location, and are not expected to cause disruptions substantially different from normal ship traffic (e.g., noise) through the area (SAIC 2000).

Ship strikes of whales have become of growing concern for several species, with ship strikes to the highly endangered North Atlantic right whale receiving the most attention off the U.S. east coast (Calambokidis 2011). In 2007, four blue whales off the coast of California were found dead with direct or indirect indications of having been struck by ships. These four were all found in the vicinity of the Santa Barbara Channel and the Los Angeles-Long Beach Harbors. Ship strikes during cable installation are highly unlikely because the speed of the ship during cable-laying activities is slower (~0.5 to 1.5 knots while plowing) than migrating whales or fast-swimming sea lions. The potential for ship strikes to sea turtles is greater than for marine mammals, especially when they surface to breathe. Although some avoidance of a cable lay ship can be anticipated as a result of general disturbance in the area, some potential for collision with marine animals remains. Active avoidance remains the best approach for preventing potential collisions between cable lay vessels and marine mammals and sea turtles. This can be accomplished through preparation and implementation of a marine mammal monitoring and avoidance plan during all cable-laying operations. These plans typically require that marine mammal observers be present on the cable installation ship, in addition to procedures for ceasing all operations if a marine mammal or sea turtle comes within a prescribed “safety zone” distance of the vessel, in order to minimize the risk of a collision.

The long-term presence of a fiber optic cable along the seafloor likely would not impede whale migrations because the cable would (1) be buried along most of the nearshore route; and (2) represent a very low profile (e.g., 1 to several inches) in hard-bottom areas as a result of careful installation and post-lay inspection/adjustment. Also, as discussed in CSLC (2000a), cable slack would be stabilized at a level within the range of 2 to 3% in areas where the cable cannot be buried to ensure that the cable conforms to the slopes and peaks of the seabed and is not suspended substantially (e.g., more than 1 foot) above the bottom. This would prevent creation of any spans that could potentially entangle marine mammals such as whales. Of the approximately two dozen known commercial fiber optic cable landings in coastal California waters installed since 2000, no known or reported entanglements between whales and fiber optic cables have occurred.

As discussed above for fishes, exposure to underwater noise from cable installation activities and work vessels also may pose some potential for acute and sublethal effects on marine mammals and sea turtles. Underwater operations can generate peak underwater noise levels ranging between 160 and 180 dB. This includes 178 dB (re 1 µPa at 1 meter) peak underwater noise levels for cable-trenching activities (Nedwell *et al.* 2003) and between 160 and 180 dB at a distance of 1 m (Caltrans 2015) for cable-laying ships and small work vessels, depending on their size and design. Small vessels tend to generate higher underwater noise levels than large ships.

NOAA (2018) established updated thresholds for the onset of PTS and TTS for impulsive and non-impulsive noise sources based on marine species hearing groups. Impulsive sources include sudden onset sounds such as explosions or pile driving, while non-impulsive sources include continuous sounds such as sonar, vibratory pile driving, and vessel movement. The NOAA established thresholds (dB re 1 µPa) identify the levels at which a marine mammal is predicted to experience changes in hearing sensitivity, whether temporary or permanent, from acute exposure to loud underwater anthropogenic sound sources. The updated impulsive noise thresholds are dual metric, meaning whichever results in the largest isopleth for calculating PTS or TTS onset should be used. The impulsive noise thresholds contain only cumulative metrics. NOAA recommends that, when the peak sound pressure level (SPL) threshold for non-impulsive noise exceeds the peak SPL noise threshold associated with impulsive sounds, the impulsive noise peak thresholds should be used. It can be assumed that the reported peak non-impulsive sound levels are more like cumulative values since non-impulsive sounds do not have the sharp initial sound wave that quickly drops lower. The cumulative PTS and TTS non-impulsive peak sound levels are presented in Table 8.1.

TABLE 8.1. CUMULATIVE SOUND EXPOSURE LEVELS FOR MARINE MAMMALS

Marine Mammal Group	Onset of Permanent Threshold Shifts (cumulative sound exposure level)	Onset of Temporary Threshold Shifts (cumulative sound exposure level)
Baleen whales	199 decibels (dB)	179 dB
Dolphin and toothed whales	198 dB	178 dB
Porpoises	173 dB	153 dB
True seals	201 dB	181 dB
Sea lions, fur seals, and sea otters[5]	219 dB	199 dB

SOURCE: NOAA 2018.

With the possible exception of the sound exposure limits for porpoises, all other underwater thresholds are greater than the underwater noise generated by cable installation equipment and vessels. For porpoises, the anticipated cumulative underwater

[5] Sea otters are managed by USFWS, and these PTS and TTS thresholds are considered advisory.

noise threshold potentially generated by cable installation vessels is at or just slightly higher than the established PTS and TTS threshold levels of 173 and 153 dB, respectively, indicating that the porpoise would need to be located very close to the noise source to potentially be affected, which is unlikely to occur. Assuming the aforementioned 5- to 6-dB drop per doubling of distance from the sound source (McKenna *et.al* 2012), potential project-generated underwater noise generated by cable lay vessels can be expected to drop to 170 dB within 13 feet of the vessel and 150 dB within 106 feet of the vessel.

As presented in Table 7.1, two species of porpoise have some potential to occur in the coastal waters offshore Eureka: Dall's porpoise and the harbor porpoise. If present during cable installation activities, the porpoises would need to be swimming within 13-100 feet of the stern of the lay ship to be affected. There are currently no known RMS values for cable installation activities, so it is not possible to estimate at what distance from the underwater sound source the NOAA-established PTS AND TTS threshold level would occur.

Little scientific information is known about the effects of anthropogenic underwater noise on marine turtles, or at what potential threshold levels acute or behavioral responses may occur (Williams *et al.* 2015). Sea turtles appear to be sensitive to low-frequency sounds with a functional hearing range of approximately 100 Hz to 1.1 kHz (Grebner and Kim 2015). Scientific information on direct measurements of underwater noise sources on marine turtles concerns impulsive sound sources (not generated from project-related activities), such as airguns and dynamite explosions (not part of the proposed project-related activities). These studies indicated that marine turtles may be somewhat resistant to successive dynamite blasts (Erbe 2012) and can detect and exhibit avoidance behavior to in response to 175 dB RMS-generating impulsive airgun sounds (Weilgart 2012) when several kilometers away from the source. Additionally, the Acoustical Society of America-developed guidelines for sound exposure criteria for fish and turtles suggested that (1) sea turtle hearing probably was more similar to that of fishes than to marine mammals; and (2) when assessing potential underwater noise effects on marine turtles, that the peak SPL acute threshold level for fish of 206 dB might be an appropriate measure (Grebner and Kim 2015). As indicated above, potential project related underwater peak SPL noise levels are expected to be in the 160-180 dB range, which is well below the 206-dB level for acute impacts. Based on the behavioral responses to impulsive-based sound sources, it is anticipated that any marine turtles approaching project-related cable installation activities would project work vessels. However, no sea turtle species are anticipated in the project area.

Although they can be expected to avoid the immediate area where the underwater noise is generated during cable lay activities, implementation of a marine mammal and sea turtle monitoring program and the presence of an observer onboard the cable installation vessel can be expected to prevent any exposure of porpoises and other marine mammals and sea turtles to underwater noise levels of sufficient magnitude to result in any deleterious effects.

As discussed above for fishes and invertebrate taxa, accidental release of any hydrocarbon-based product has the potential to affect marine mammals and sea turtles that are present in the area affected by the accidental release. Preparation and implementation of a spill prevention, training, and response procedures plan can be expected to prevent the occurrence of accidental hydrocarbon releases from cable installation and maintenance activities, as well as to limit the volume of any released material and therein the potential effects on marine taxa, should it occur.

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