

NORTHERN RIGHT-WHALE DOLPHIN (*Lissodelphis borealis*): California/Oregon/Washington Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Northern right-whale dolphins are endemic to temperate waters of the North Pacific Ocean. Off the U.S. west coast, they have been seen primarily in shelf and slope waters (Figure 1), with seasonal movements into the Southern California Bight (Leatherwood and Walker 1979; Dohl *et al.* 1980; 1983). Sighting patterns from aerial and shipboard surveys conducted in California, Oregon and Washington during different seasons (Green *et al.* 1992; 1993; Forney and Barlow 1998; Barlow 2016) suggest seasonal north-south movements, with animals found primarily off California during the colder water months and shifting northward into Oregon and Washington as water temperatures increase in late spring and summer. The southern end of this population's range is not well-documented, but during cold-water periods, they probably range into Mexican waters off northern Baja California. Genetic analyses have not found statistically significant differences between northern right-whale dolphins from the U.S. West coast and other areas of the North Pacific (Dizon *et al.* 1994); however, power analyses indicate that the ability to detect stock differences for this species is poor, given traditional statistical error levels (Dizon *et al.* 1995). Although northern right-whale dolphins are not restricted to U.S. territorial waters, there are currently no international agreements for cooperative management. For the Marine Mammal Protection Act (MMPA) stock assessment reports, there is a single management stock including only animals found within the U.S. Exclusive Economic Zone of California, Oregon and Washington.

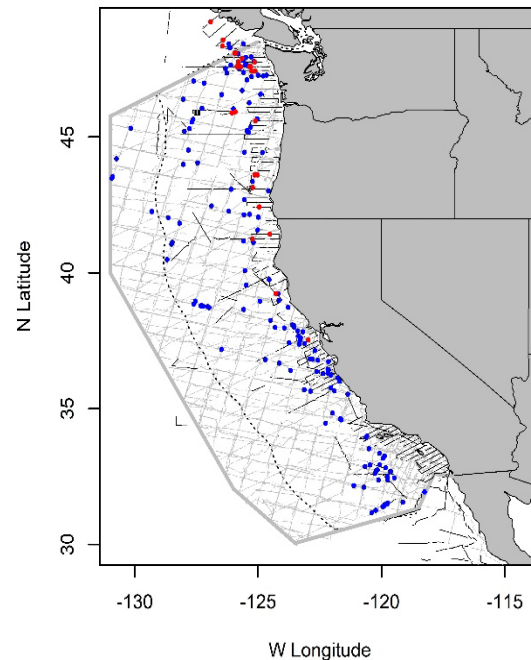


Figure 1. Northern right whale dolphin sightings based on shipboard surveys off California, Oregon, and Washington, 1991-2018. Dashed line represents U.S. EEZ, thin lines indicate completed transect effort (gray = 1991-2014, black = 2018). Sightings from the 2018 survey are shown in red.

POPULATION SIZE

The distribution of northern right-whale dolphins throughout this region is highly variable, apparently in response to oceanographic changes on both seasonal and inter-annual time scales (Forney and Barlow 1998, Barlow 2016). As oceanographic conditions vary, northern right-whale dolphins may spend time outside the U.S. Exclusive Economic Zone. Becker *et al.* (2020) generated species distribution models (SDMs) from fixed and dynamic ocean variables using 1991-2018 line-transect survey data to estimate density and abundance of cetaceans in the California Current Ecosystem (CCE). The use of SDMs for density estimation is well-established for this region and models incorporate changes in species abundance and habitat shifts over time (Becker *et al.* 2012, 2016, 2017, Redfern *et al.* 2017). Additionally, use of SDMs facilitates abundance estimation when survey coverage is limited, as was the case in 2018 when line-transect effort was largely limited to continental shelf waters (Henry *et al.* 2020). The best-estimate of abundance is taken as the estimate from 2018, or 29,285 (CV=0.717) animals (Becker *et al.* 2020).

Minimum Population Estimate

The log-normal 20th percentile of the 2018 abundance estimate is 17,024 northern right-whale dolphins (Becker *et al.* 2020).

Current Population Trend

The distribution and abundance of northern right whale dolphins off California, Oregon and Washington varies considerably at both seasonal and inter-annual time scales (Forney and Barlow 1998, Becker *et al.* 2012, 2020, Barlow 2016), but no long term trends have been identified (Figure 2).

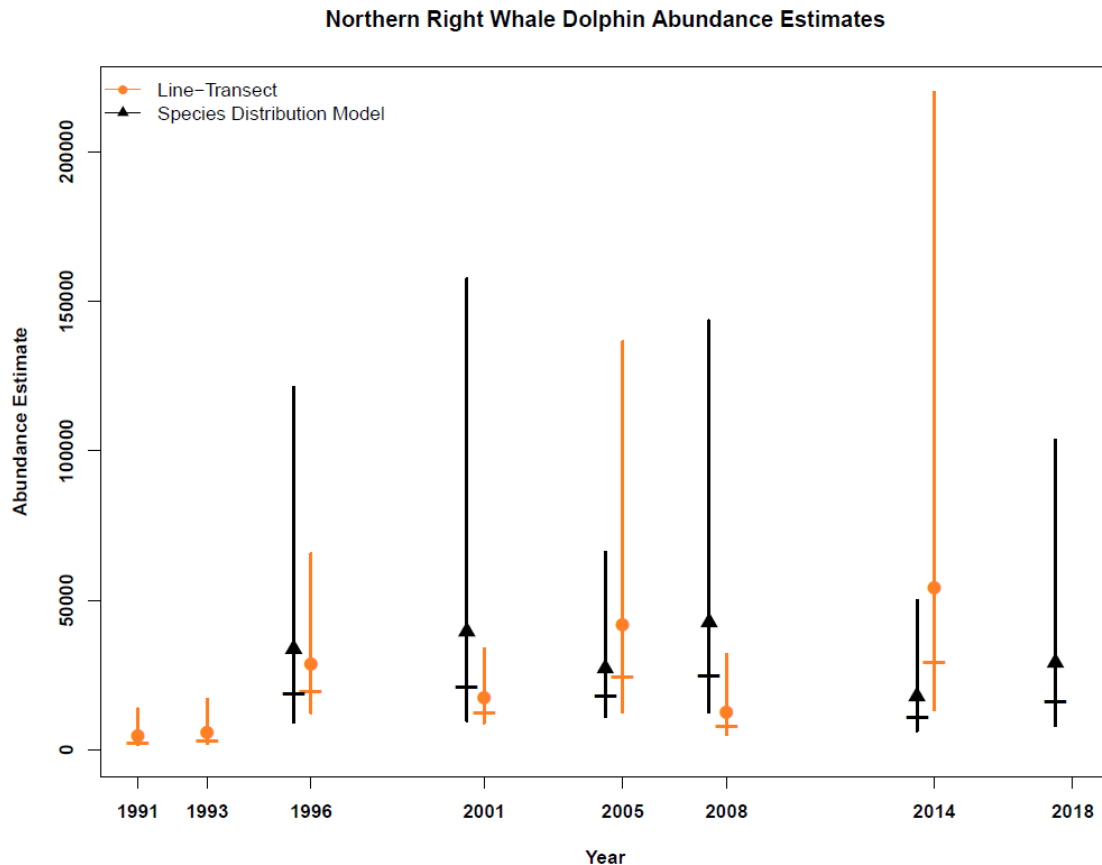


Figure 2. Abundance estimates and 95% confidence intervals from vessel-based line transect surveys (Barlow 2016) and species distribution models (Becker *et al.* 2020) within the California Current. Line-transect surveys in 1991 and 1993 did not include the waters of Oregon and Washington. Horizontal hatch marks represent minimum population size estimates based on 20th percentiles of mean estimates.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No information on current or maximum net productivity rates is available for northern right-whale dolphins off the U.S. west coast.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (17,024) times one half the default maximum net growth rate for cetaceans ($\frac{1}{2}$ of 4%) times a recovery factor of 0.48 (for a species of unknown status with a mortality rate CV between 0.3 and 0.6; Wade and Angliss 1997), resulting in a PBR of 163 northern right-whale dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Killer Whale (*Orcinus orca*): Eastern North Pacific Offshore Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Killer whales are observed worldwide from the tropics to polar regions (Leatherwood and Dahlheim 1978), although they prefer colder waters of both hemispheres, with greatest abundances found within 800 km of major continents (Mitchell 1975, Forney and Wade 2006). Near the west coast of North America, killer whales occur along the entire Alaskan coast (Braham and Dahlheim 1982, Hamilton *et al.* 2009), in British Columbia and Washington inland waterways (Bigg *et al.* 1990), and along the outer coasts of Washington, Oregon and California (Hamilton *et al.* 2009). Seasonal and year-round occurrence are noted for killer whales throughout Alaska (Braham and Dahlheim 1982) and in the intra-coastal waterways of British Columbia and Washington, where three ecotypes are recognized: 'resident', 'transient' and 'offshore' (Bigg *et al.* 1990, Ford *et al.* 1994), based on aspects of morphology, ecology, genetics and behavior (Ford and Fisher 1982; Baird and Stacey 1988; Baird *et al.* 1992, Hoelzel *et al.* 1998, Morin *et al.* 2010, Ford *et al.* 2014). Offshore killer whales are known from southern California waters north to the Aleutian Islands and are considered to represent a single network of socially-connected individuals (Dahlheim *et al.* 2008, Ford *et al.* 2014). Photographic matches of individuals between Dutch Harbor, Alaska and southern California waters near Dana Point are documented (Dahlheim *et al.* 2008). Offshore killer whales apparently do not mix with transient and resident killer whale stocks in these regions (Ford *et al.* 1994, Black *et al.* 1997). Studies indicate the 'offshore' type, although distinct from the other types ('resident' and 'transient'), appears to be more closely related genetically, morphologically, behaviorally, and vocally to 'resident' type killer whales (Black *et al.* 1997, Hoelzel *et al.* 1998, Morin *et al.* 2010). Global genetic studies suggest that residents and transient ecotypes warrant subspecies recognition (Morin *et al.* 2010) and each are currently listed as unnamed subspecies of *Orcinus orca* ([Committee on Taxonomy 2018](#)). Currently, the offshore killer whale ecotype is included under *Orcinus orca* ([Committee on Taxonomy 2018](#)).

Based on association patterns, acoustics, movements, genetic differences and potential fishery interactions, eight killer whale stocks are recognized within the Pacific U.S. EEZ: (1) the Eastern North Pacific Alaska Resident stock - occurring from Southeast Alaska to the Bering Sea, (2) the Eastern North Pacific Northern Resident stock - occurring from British Columbia through Alaska, (3) the Eastern North Pacific Southern Resident stock - occurring mainly within the inland waters of Washington State and southern British Columbia but extending from central California into southern Southeast Alaska, (4) the West Coast Transient stock - occurring from Alaska through California, (5) the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock - occurring from southeast Alaska to the Bering Sea, (6) the AT1 Stock - found only in Prince William Sound, (7) the Eastern North Pacific Offshore stock - occurring from Alaska through California, and (8) the Hawaiian stock. The Stock Assessment

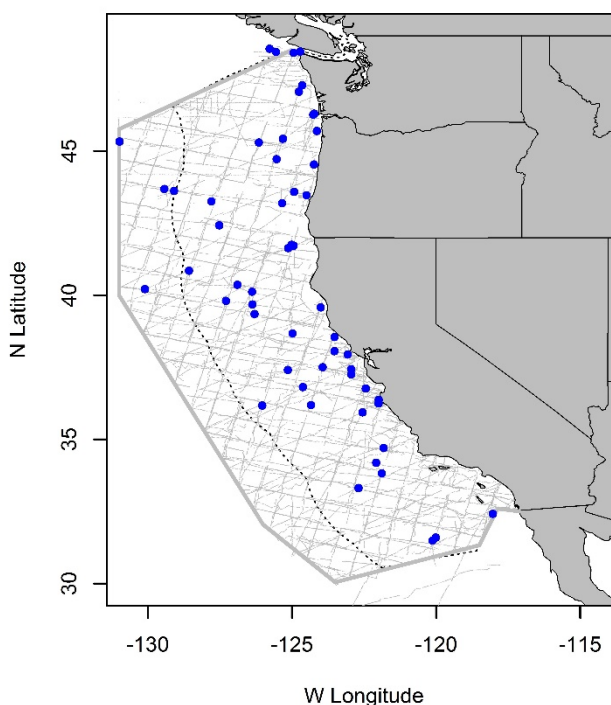


Figure 1. Sightings of killer whales (all ecotypes/stocks) encountered during Southwest Fisheries Science Center line-transect vessel surveys in the California Current ecosystem, 1991-2014.

Reports for the Alaska Region contains data on Eastern North Pacific Alaska Resident, Eastern North Pacific Northern Resident and the Gulf of Alaska, Aleutian Islands, and Bering Sea, AT1, and West Coast Transient stocks.

POPULATION SIZE

Population size of the eastern North Pacific stock of offshore killer whales is estimated with photo-ID mark-recapture methods at 300 whales (95% Highest Posterior Density Interval (HPDI) = 257–373, CV=0.10), including marked and unmarked individuals encountered from 1988-2012 (Ford *et al.* 2014). This study included 157 encounters of 355 distinct whales from the Aleutian Islands to southern California. The cumulative number of unique animals reported via a ‘discovery curve’ was not asymptotic, implying that additional individuals are undocumented. Most encounters (n=85) during the photo-ID study were from southeast Alaska and Vancouver Island, where survey effort was most intense. The fraction of this population utilizing U.S. waters is unknown and the number of animals using areas outside of the currently known geographic range (Aleutian Islands to southern California) is unknown.

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the estimate ($N=300$, CV=0.1) reported by Ford *et al.* (2014), or 276 animals.

Current Population Trend

The population trajectory for eastern North Pacific offshore killer whales is described as ‘stable’ by Ford *et al.* (2014). The stable designation includes considerations such as an estimated average annual survival rate of 0.98 (95% HPDI = 0.92–0.99) and annual recruitment rates of 0.02 (95% HPDI = 0–0.07) (Ford *et al.* 2014).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Annual recruitment rates of 2% (95% HPDI = 0 – 7%) were estimated by Ford *et al.* (2014) for offshore killer whales, based on a Bayesian mark-recapture model.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (276) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no known fishery mortality; Wade and Angliss 1997), resulting in a PBR of 2.8 offshore killer whales.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Offshore killer whales have not been documented killed by anthropogenic sources in Alaska or U.S. west coast waters, but mortalities are likely to be undetected, given the offshore range of this ecotype. Ford *et al.* (2014) reports one offshore killer whale injury (severed dorsal fin) due to a vessel strike, but does not report a location or year. Offshore killer whales are likely vulnerable to the same anthropogenic threats (fishery interactions, vessel strikes, sonar) as other killer whale stocks.

Table 1. Data on incidental mortality and injury of Eastern North Pacific Offshore killer whales in commercial fisheries. No killer whale entanglements have been observed in the CA swordfish drift gillnet fishery since 1995, when a single whale was killed (Carretta *et al.* 2018a). The whale was genetically identified as a transient ecotype and is the only killer whale observed entangled in the fishery over a 27-year period (Carretta *et al.* 2017, 2018). Bycatch estimates for the fishery appear in Table 1 and are based on a bycatch model that pools all years of observer data, but does not include the observation of a transient killer whale.

Fishery Name	Data Type	Years	Percent Observer Coverage	Observed Mortality	Estimated Annual Mortality	Mean Annual Takes (CV)
CA thresher shark/swordfish drift gillnet	Observer	2012	19%	0	0	0
		2013	37%	0	0	
		2014	24%	0	0	
		2015	20%	0	0	
		2016	18%	0	0	
Minimum total annual takes						0

STATUS OF STOCK

The status of Eastern North Pacific offshore killer whales in relation to OSP is unknown. The estimated population size is described as 'stable' by Ford *et al.* (2014). No habitat issues are known to be of concern for this stock. The tendency for whales in this population to occur in large groups, sometimes between 50 -100 animals, combined with the small population size, raises concern that a relatively large fraction of the population faces exposure risk to such anthropogenic events as fishery interactions, vessel strikes, oil spills, or military sonar (Ford *et al.* 2014). Offshore killer whales are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. There has been no documented human-caused mortality of this stock but Ford *et al.* (2014) reported one injury due to a vessel strike. It is likely that undetected mortality and injury of killer whales from this stock occurs in gillnets and other fishing gear. Along the U.S. west coast, observations of the California swordfish drift gillnet fishery includes one *transient* killer whale entangled and killed during 8,845 fishing sets from 1990-2016 (Carretta *et al.* 2017a, Carretta *et al.* 2018). Documented injuries and mortalities of offshore killer whales due to anthropogenic sources are extremely rare, and the fishery most likely to interact with them along the U.S. west coast has not had a documented interaction in 27 years, therefore Eastern North Pacific offshore killer whales are not classified as a "strategic" stock under the MMPA. The total fishery mortality and serious injury for offshore killer whales is considered to be insignificant and approaching zero mortality and serious injury rate.

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