

Marine Shipping Working Group

Proposals

For Discussion at the Marine Shipping Working Group Meeting on October 7th and 8th

The following proposals were submitted in SeaSketch. Please refer to the forum to view the full discussion:
<http://seasket.ch/hwLR3UaVR2>

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Preliminary Management Option Idea to reduce the risk of ship strikes on protected whales in the Channel Island National Marine Sanctuary

Prepared by the Natural Resources Defense Council (NRDC) for the Marine Shipping Working Group (MSWG)

Overview

As a member of the Channel Islands National Marine Sanctuary (CINMS) Marine Shipping Working Group (MSWG), NRDC has developed a “preliminary management option idea” using the marine spatial planning tool “SeaSketch.” In NRDC’s capacity as a stakeholder with expertise in whales and an interest in whale conservation, the preliminary management option idea submitted by NRDC focuses on the first goal of the MSWG, namely to *reduce the risk of ship strikes on endangered whales*.

This document presents: 1) an evaluation of the data layers available in SeaSketch for the identification of important areas for blue, humpback, fin and gray whales and a rationale for the selection of the data layers used to develop the preliminary management option idea; 2) a summary of important whale areas in the region; 3) an assessment of current shipping lanes and management tools aimed at reducing ship strikes; and 4) the preliminary management option idea to better reduce the risk of ship strikes on protected whales.

1. Evaluation of potential data layers

Appendix 1 presents an evaluation of the whale data layers available in SeaSketch for developing a proposal to reduce ship strikes of whales in the CINMS. In recognition that sampling bias and other limitations are inherent to varying extents in all the available data sets, we selected the following four data sets that we deemed to be the most robust representation of whale distribution in the region to develop the proposal:

- **Biologically Important Areas (BIAs)** (blue, humpback, and gray whales)
- **Channel Islands Naturalist Corps Observations** for summer (June-September) and winter (blue, humpback, fin, and gray whales)
- **Habitat density models** (blue, humpback, and fin whales)
- **Eastern North Pacific blue whale 90% home range based on Argos satellite tracks**

2. Summary of important whale areas

Figures 1-4 illustrate the location of important whale areas in the CINMS based on the four most robust data layers included in SeaSketch. An important consideration when developing management tools for baleen whales is that while these species select these biologically important areas, and so may exist at higher densities within them, they frequently move between these areas. Whales are therefore also at significant risk of ship strikes in areas that are *not* recognized as biologically important and this needs to be accounted for in the development of management recommendations.

In June to October, blue whales (Figure 1) occupy feeding habitat close to the 200-m isobaths in waters that have intermediate mixed layer depths and high concentrations of surface chlorophyll in areas close to shore and which also extend into the Santa Barbara Channel in the north and offshore waters further south (Redfern et al. 2013; Calambokidis et al. 2015). The blue whale BIA “Santa Barbara Channel and San Miguel” biologically important feeding area, high density areas (Figure 1a), and the 90% home range (Figure 1b), coincide along the western and southern portion of the Santa Barbara channel, indicating that this is a priority area for protection (Figure 1)¹. However, significant numbers of observations of blue whales extend further east along the southern portion of the channel indicating that this is also an area at high risk of ship strikes.

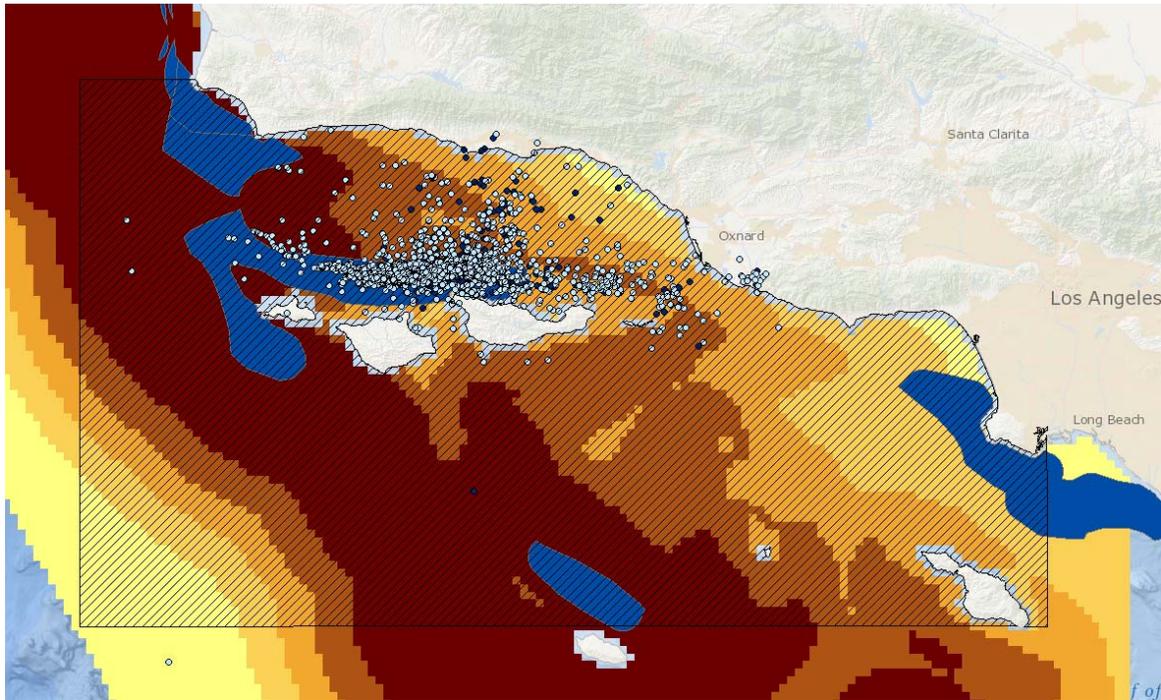
From March to September, humpback whales (Figure 2) feed in productive coastal waters characterized by cold temperatures, low salinities and high chlorophyll concentrations (Redfern et al. 2013; Calambokidis et al. 2015). The humpback whale “Santa Barbara Channel and San Miguel” biologically important feeding area partly overlaps in the west with an area predicted to have high humpback whale densities by the habitat density model; however there is an area to the northwest that is not accounted for in the BIA. In addition, the eastern portion of the BIA overlaps with high densities of field observations of humpback whales throughout the Santa Barbara Channel. Similar to the blue whale data set, these observations extend further east than the BIA, particularly in the winter, although sampling bias precludes any firm conclusions being made about seasonal differences in distribution.

Fin whales (Figure 3) have been found to prefer offshore waters characterized by cold surface temperatures, intermediate mixed-layer depths, and intermediate concentrations of surface chlorophyll (Redfern et al. 2013). Data on fin whales is sparse resulting in no BIAs being developed for this species. While the habitat density model output suggests areas to the southwest of the CINMS may be more important for fin whales, there have been a number of observations in the southern and central-eastern portions of the Santa Barbara channel indicating that fin whales use this area with some frequency throughout the season.

Gray whales (Figure 4) may migrate through the Santa Barbara channel from October to July. The migration corridors used by most gray whales are within 10 km of the U.S. west coast, although they have been observed taking a more direct route across large bodies of water off California. In the Southern California Bight, however, migrating gray whales may deviate farther from the mainland as some individuals are routinely seen near the Channel Islands. Mother calf pairs are more likely to stay closer to the shore than adults or juveniles (Calambokidis et al. 2015). The field observations of gray whales generally reflect the 10 km vicinity to shore delineated by the gray whale BIA (Figure 4).

¹ Given the significant overlap between the habitat density model output and the 90% home range based on ARGOS satellite telemetry data (Figures 1a and 1b) only the habitat density layer is used in subsequent figures for blue whales.

(a)



(b)

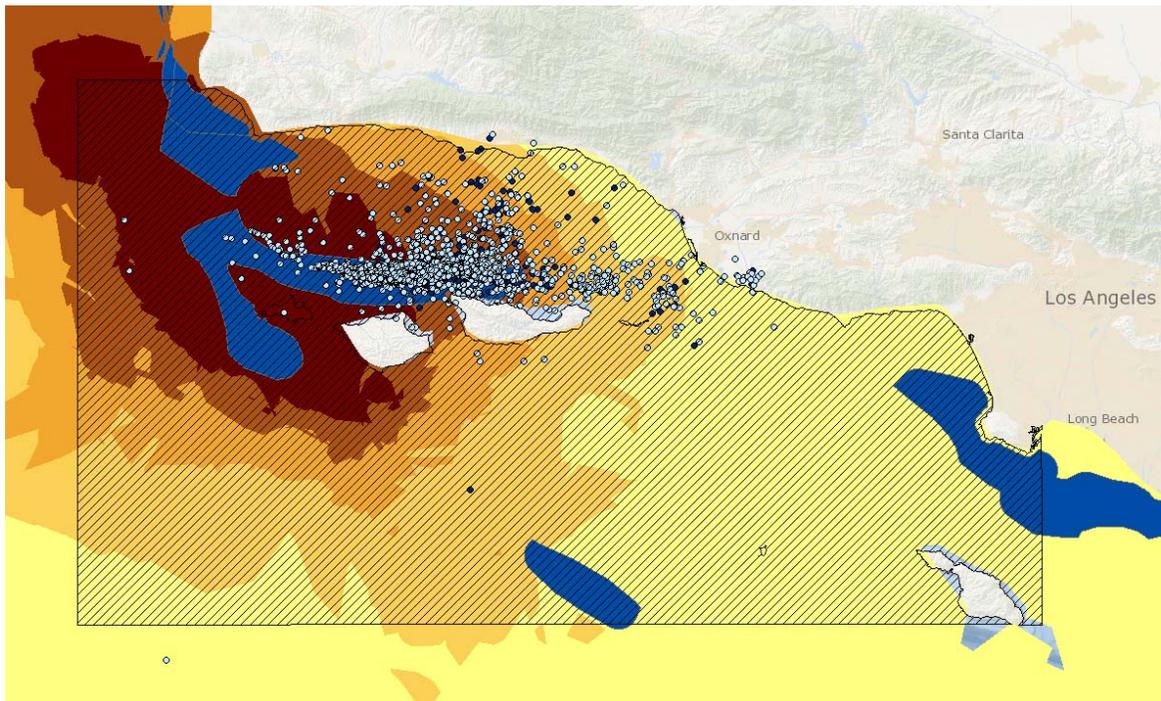


Figure 1: Blue whale sighting data for summer (light blue points) and winter (dark blue points) overlaid on blue whale biologically important feeding habitat (blue polygons) and (a) blue whale density habitat map (brown, higher density; yellow, lower density), and (b) blue whale 90% home range 1998-2008 (darker colors indicate higher overlap of satellite tracks).

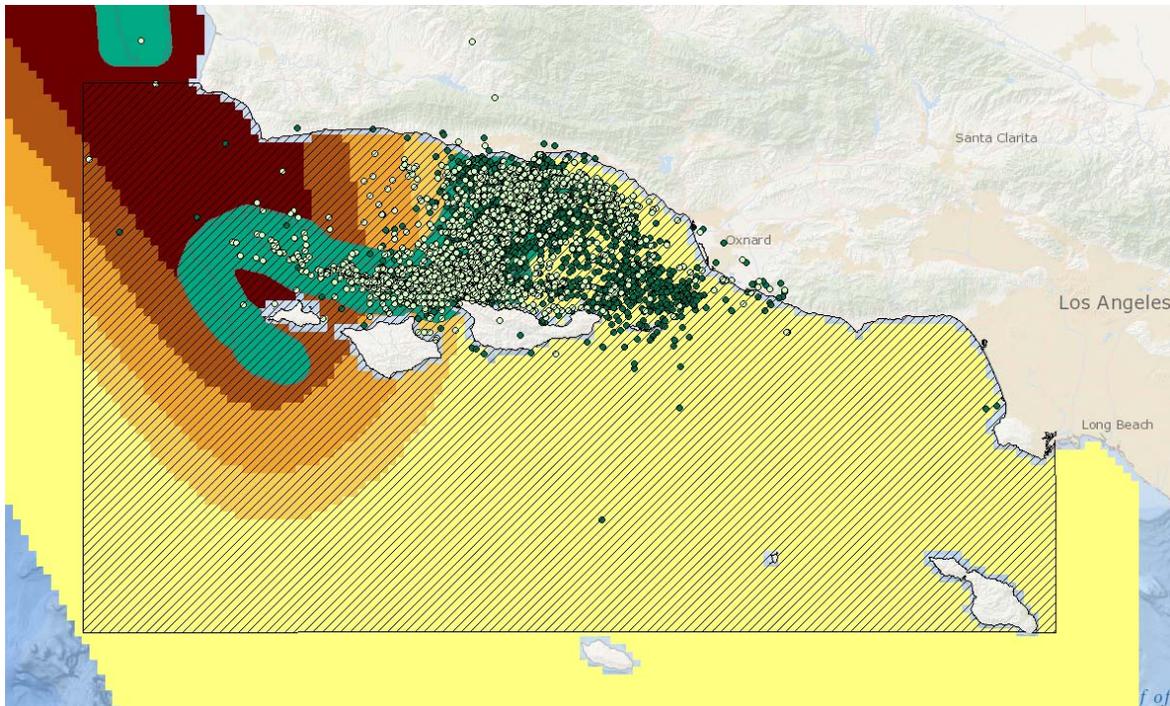


Figure 2: Humpback whale sighting data for summer (light green points) and winter (dark green points) overlaid on humpback whale biologically important feeding habitat (green polygons) and the humpback whale density habitat map (brown, higher density; yellow, lower density).

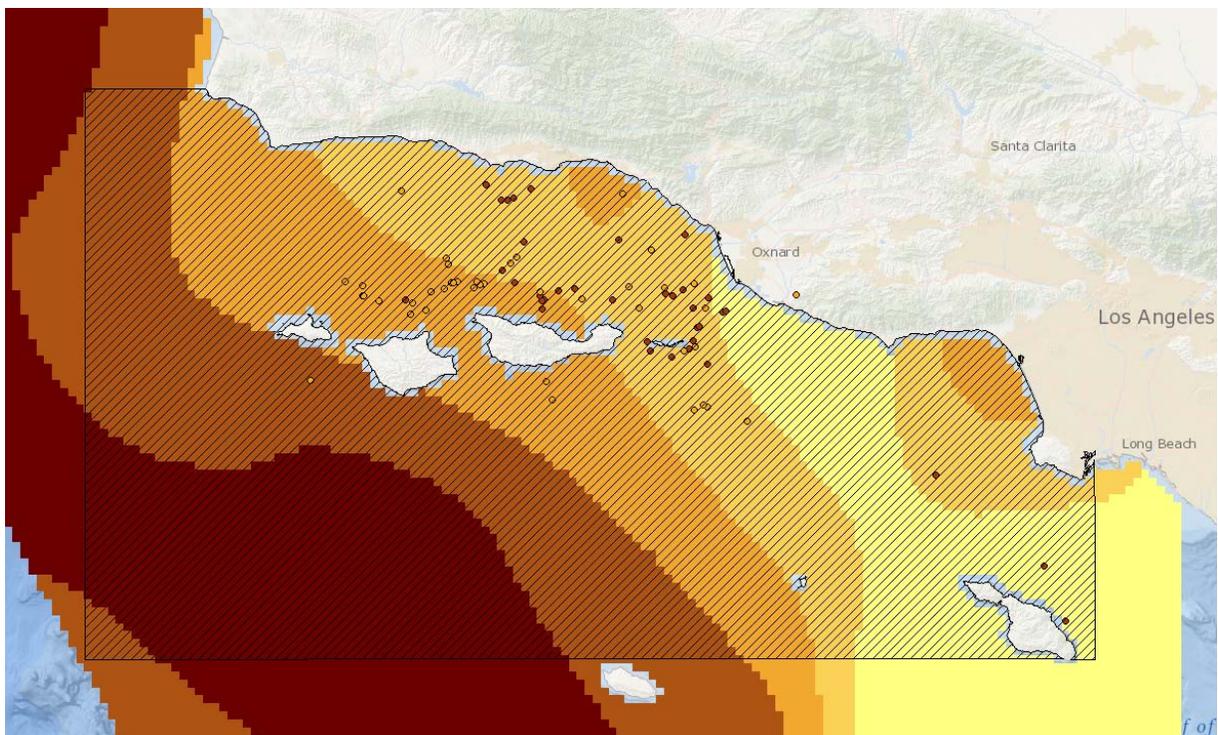


Figure 3: Fin whale sighting data for summer (orange points) and winter (red points) overlaid on the fin whale density habitat map (brown, higher density; yellow, lower density).

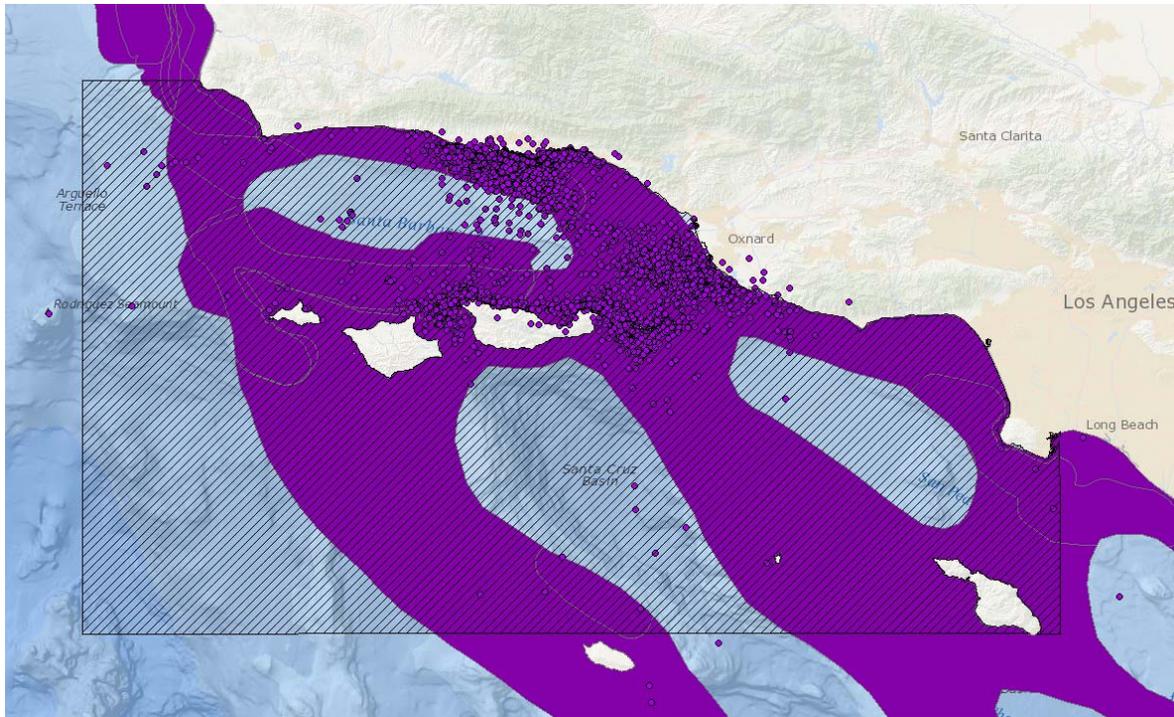


Figure 4: Gray whale sighting data (purple points) overlaid on the gray whale biologically important migratory habitat (purple polygons).

3. Existing shipping lanes and management tools to reduce ship strikes

Current shipping lanes in the CINMS directly overlap with areas considered biologically important for blue whales, areas predicted to host high densities of blue whales, and also the southern and eastern portion of the Santa Barbara channel where high numbers of blue whale observations have been recorded (Figures 1 and 5). The shipping lane in the Santa Barbara channel also intersects directly with a biologically important foraging area for humpback whales, areas with high densities of humpback whale sightings in the central and eastern portions of the channel, and also an area predicted to have high humpback whale density to the west of the channel (Figures 2 and 5). Although more research needs to be conducted into distribution of fin whales in this region, sighting data of fin whales in the Santa Barbara channel and predictions of high density areas suggest that the shipping lane currently passes through fin whale habitat, and particularly in the Santa Barbara channel and the area northwest of the port of Los Angeles (Figures 3 and 5). Finally, there is significant overlap of the shipping lanes in the CINMS with biologically important areas for migrating gray whales, the location of which are supported by sightings data (Figures 4 and 5). The intersection of the shipping lane with migratory habitat to the west and east of the Santa Barbara channel, and also directly offshore from the port of Los Angeles, are of particular concern as the most vulnerable life history stages (i.e. mother calf pairs) are likely to select these areas due to their proximity to shore and shallower waters relative to areas south of the Channel Islands.

While the slow speed zone implemented by NOAA² offers some protection by providing incentives to reduce ship speeds to 10 knots (i.e. the speed at which mortality from ship strikes is significantly reduced), it does not encompass the high density areas to the south east of the Santa Barbara channel and does not in itself guarantee protection as shippers adhere to the zone’s guidelines on a voluntary basis. A large portion of the area in the western and southern portion of the Santa Barbara channel indicated as important to protected whales by all the data sets falls within waters regulated by the International Maritime Organization (IMO) (Figure 5). Ships are advised to avoid these areas by the IMO and so risk of ship strikes can be considered low under current regulatory mechanisms. Similarly the current LA/LB Speed Reduction Incentive Program offers some protection in the vicinity of the port by providing an incentive to reduce ship speeds to 12 knots (Figure 5). In consideration of the known and predicted distribution of protected whales in the CINMS, we conclude that current mechanisms aimed at reducing the frequency and lethality of ship strikes on protected whales are seriously inadequate, and particularly within the Santa Barbara channel.

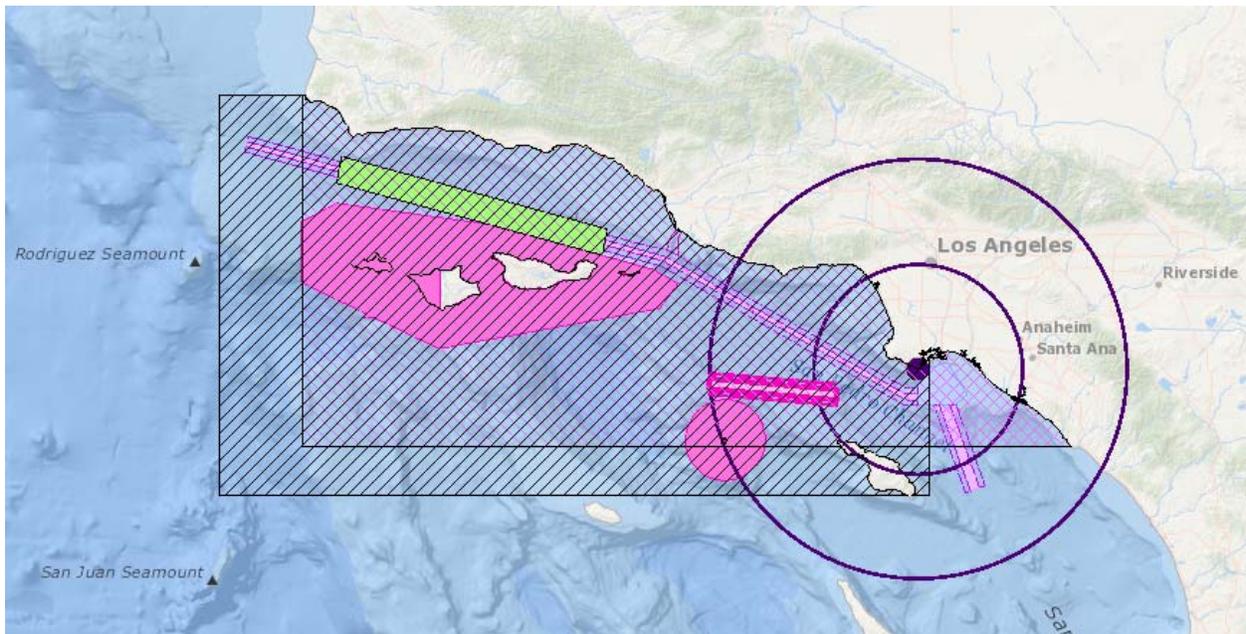


Figure 5: Current location of permanent (pink lines) and voluntary (short, bold pink line) shipping lanes, IMO regulations (pink polygons), 2015 whale advisory zone (pink hatching), slow speed zone (green rectangle), and LA/LB speed reduction incentive program (dark blue circles, overlaid on the CINMS extent (right diagonals)).

² NOAA strongly recommends that vessels 300 gross registered tons or larger transiting the Santa Barbara Channel traffic separation scheme in the area between Point Conception and San Pedro Point, Santa Cruz Island do so at speeds not in excess of 10 knots due to endangered whales in this area.

4. Preliminary management option idea to reduce ship strikes on protected whales

Based on the identification of important areas for protected whales, an assessment of current shipping lanes and management tools, NRDC presents the following preliminary management option idea to reduce ship strikes on protected whales in the CINMS (link to SeaSketch project). Our preliminary management option idea is comprised of multiple management components that are intended to be considered as a single ‘package’ where each component is dependent on the others for success.

Recommendation 1: Adopt the “Bathymetric feature avoidance/CINMS avoidance” shipping lane proposal.

Rationale: In consideration of the significant overlap of the current shipping lane in the Santa Barbara Channel and areas identified using available data as biologically important or as exhibiting high densities of individuals, and also data gaps and biases to the south of the Channel Islands, NRDC recommends relocating the shipping lane to the south of the Channel Islands following the principle of bathymetric feature avoidance. As there is significant scientific evidence demonstrating the association of bathymetric features with whale foraging habitat, we view this proposal – that avoids areas of bathymetric complexity such as shelf areas and seamounts - as the most precautionary measure to protect these protected species given that their fine-scale distribution across the region is not currently known. The Santa Barbara channel represents a narrow area of high bathymetric complexity which, as supported by sightings data, we predict is likely to promote high densities of individuals and increase the likelihood of ship strikes compared to the region south of the Channel Islands.

Outcomes:

- Avoid biologically important areas for blue (Figure 6) and humpback whale (Figure 7).
- Minimize overlap with predicted high density areas for blue whales (Figure 6) and avoid areas predicted high density areas for humpback whales (Figure 7).
- Avoid areas within the Santa Barbara channel with a high number of sightings for blue, humpback, and gray whales (Figure 6, 7 & 9).
- Minimize overlap with biologically important migratory areas for gray whales (Figure 9). Gray whale densities are predicted to be lower in these areas than within 10 km of the coast and comprise a lower proportion of mother-calf pairs.
- Minimize overlap with important bathymetric features likely to be associated with fin whale aggregations within the high density area identified for fin whales³ (Figure 8).

Recommendation 2: Implement a slow speed zone (maximum speed: 10 knots) for the relocated shipping lane within the CINMS area, and enforce it as compulsory from March-October.

Rationale:

³ Note that the explanatory power of the habitat-based density model for fin whales is only 17% (Redfern et al. 2013).

Fatality of whales from ship strikes is significantly reduced when ship speed is limited to 10 knots or less. In consideration of the data gaps for the fine-scale distribution of blue, humpback and fin whales across the region, NRDC proposes a seasonal and compulsory 10 knot speed zone for the shipping lane.

Outcomes:

- Reduce likelihood of fatal ship strikes occurring in predicted high density areas for blue whales in June-October (Figure 6).
- Reduce likelihood of fatalities from ship strikes for humpback whales in March-September (Figure 7).
- Given the lack of data available on fin whale distribution, reducing speeds across this region will serve to reduce fatalities of fin whales until more data is available to develop more prescriptive management measures (Figure 8).

Recommendation 3: Extend the 2015 Whale Advisory Zone to the western and southern CINMS boundaries.

Rationale:

Both sightings data and models indicate that protected whales and their habitat are widely distributed across the CINMS. As fine-scale distribution information is not known, NRDC proposes extending the 2015 Whale Advisory Zone to encompass the entire CINMS to direct shippers to exercise caution and reduce speed if whales are sighted.

Outcomes:

- Reduced likelihood of ship strikes for all species across the entire CINMS.

Recommendation 4: Reduce the maximum speed for the LA/LB Speed Reduction Incentive Program from 12 knots to 10 knots.

Rationale:

Fatality of whales from ship strikes is significantly reduced when ship speed is limited to 10 knots or less. The current LA/LB Speed Reductive Incentive Program area overlaps directly with important whale habitat and a major port, suggesting that the risk of ship strikes may be elevated in this area. NRDC recommends reducing the speed from 12 knots to 10 knots in this area to reduce the number of fatal ship strikes.

Outcomes:

- Reduce risk of fatal ship strikes within biologically important blue whale areas (Figure 6).
- Reduce risk of fatal ship strikes within predicted high density areas for fin whales (Figure 8).
- Reduce risk of fatal ship strikes in biologically important migratory areas for gray whales, which are likely to occur at higher densities within 10 km of the coast and comprise a higher proportion of mother-calf pairs (Figure 9).

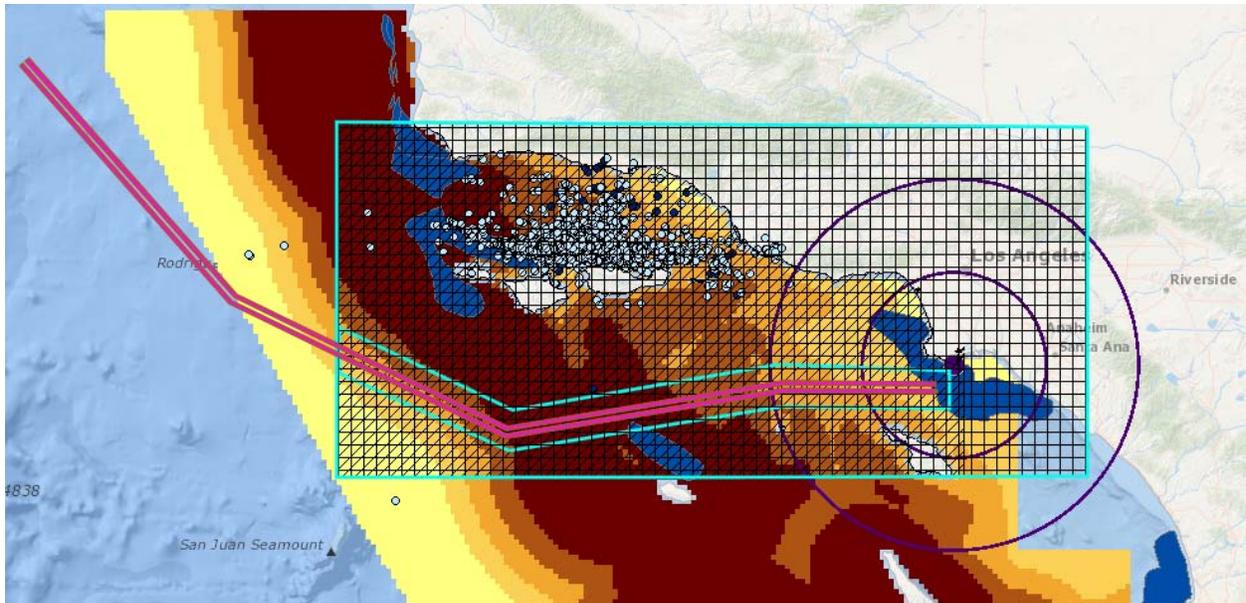


Figure 6: Proposed new location of shipping lane (pink line), a revised whale advisory zone (hatching), a proposed slow speed zones (blue rectangle encompassing shipping lane), and the current LA/LB speed reduction incentive program (dark blue circles) overlaid on blue whale data described in Figure 1a.

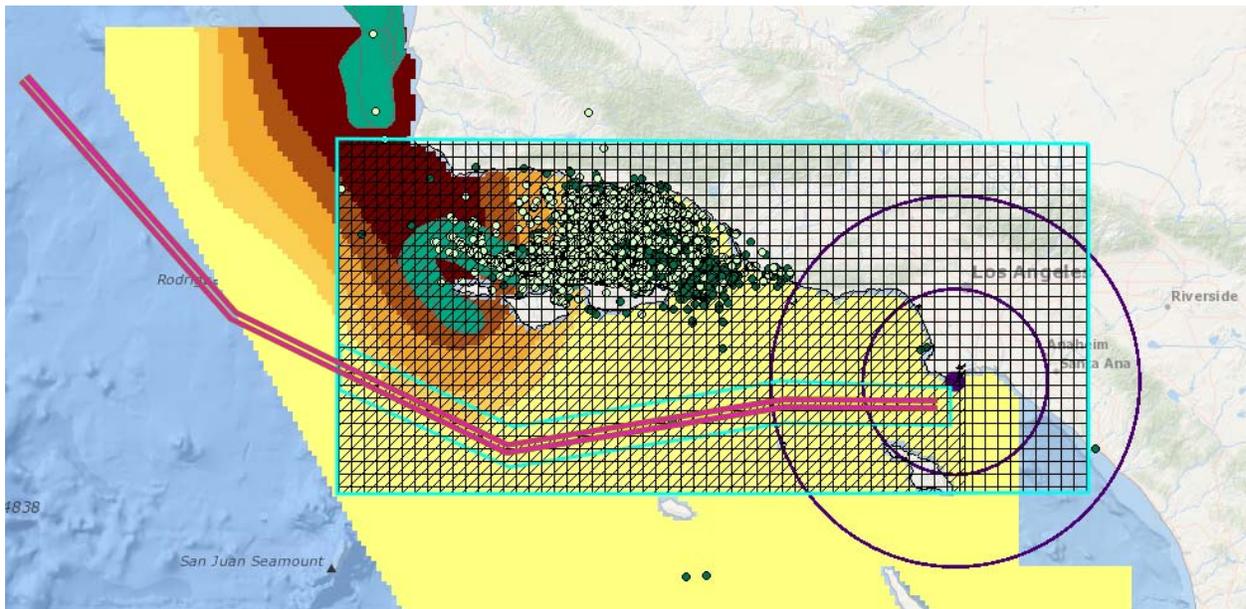


Figure 7: Proposed new location of shipping lane (pink line), a revised whale advisory zone (hatching), a proposed slow speed zones (blue rectangle encompassing shipping lane), and the current LA/LB speed reduction incentive program (dark blue circles) overlaid on humpback whale data described in Figure 2.

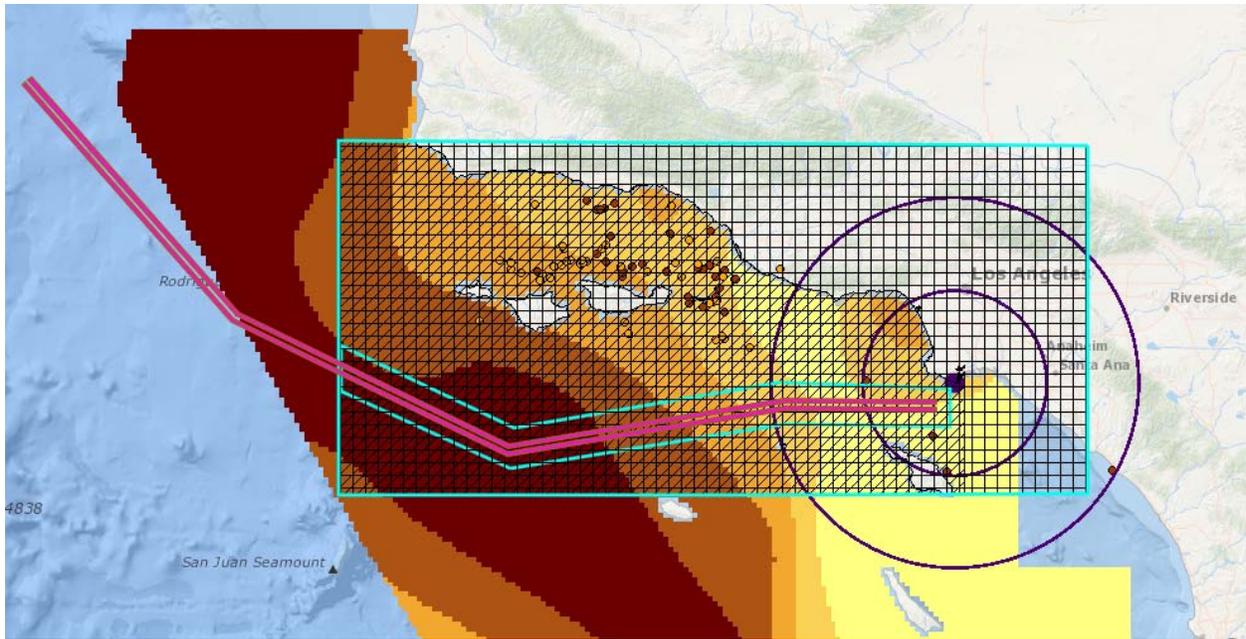


Figure 8: Proposed new location of shipping lane (pink line), a revised whale advisory zone (hatching), a proposed slow speed zones (blue rectangle encompassing shipping lane), and the current LA/LB speed reduction incentive program (dark blue circles) overlaid on fin whale data described in Figure 3.

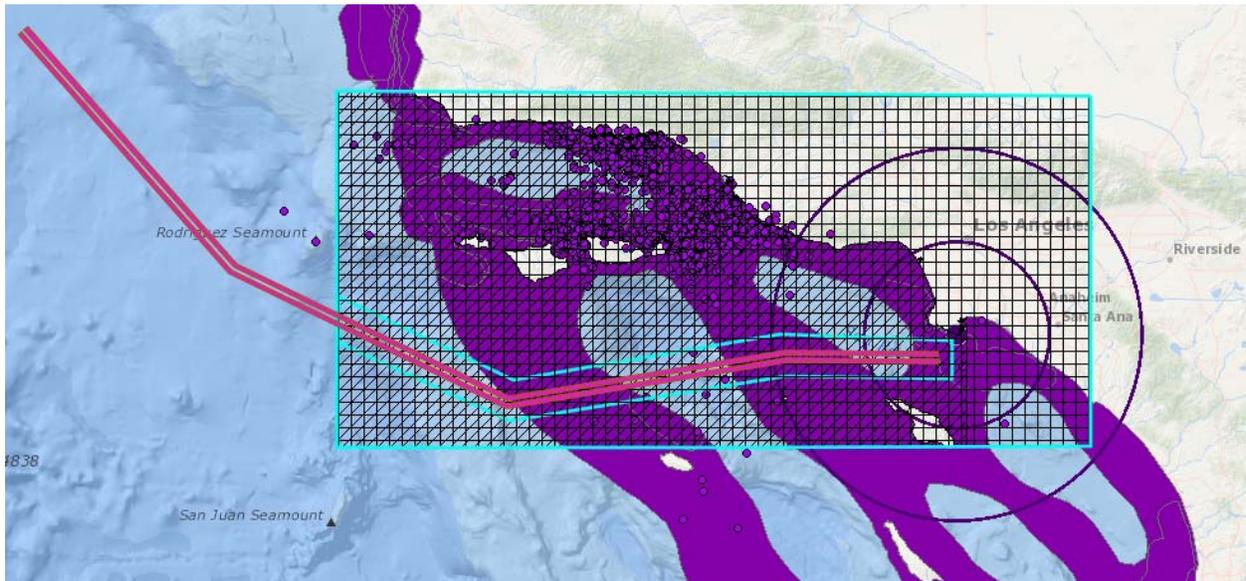


Figure 9: Proposed new location of shipping lane (pink line), a revised whale advisory zone (hatching), a proposed slow speed zones (blue rectangle encompassing shipping lane), and the current LA/LB speed reduction incentive program (dark blue circles) overlaid on gray whale data described in Figure 4.

Technology Based Approach for Risk Minimization for Whale Strikes

The following proposal was crafted with input from the LA/LB Marine Exchange, PMSA, NAVY and USAF. It is not a spatial proposal and has no SeaSketch layer associated.

Background:

The current group approach focusing on new shipping lanes does not ensure a reduction in ship strikes and could even result in increased strikes for some species. Designing some rules to minimize risk, with the least amount of impact to the shipping industry, and no negative impact to Navy operation, may actually be something everyone could sign on to. This risk based approach would have to be accepted by the whole group. There will never be 100% compliance nor will there ever be 100% assurance that there will never be a ship strike. The goal is to minimize and get as near to zero ship strikes as possible.

The two issues that need to be resolved are: 1) The group needs to get away from mapping different routes and live with the fact that new routes are difficult to implement, not based on data, not guaranteed to have the intended result, and that ship strikes will occur in the future regardless of what approach is taken; and 2) The shipping industry must support recommended guidelines. High percentage of ship support is TBD, but the industry has already demonstrated a willingness to work with the Navy on schedule and path adjustments based on operations.

Proposal Outline:

- a. Make use of the CINMS and NOAA database and server technology (or other appropriate location with USCG and stakeholder support) to be the center point to capture all whale sightings. Provide real-time data updates from this database to the Marine Exchange so they can forward the information to the shipping industry.
- b. Agree to support and FUND new technology development to assist with collecting sightings information (Navy, Industry, Sanctuary, and NGOs) - increase data input into central recipient as it is available
- c. When sightings are within or near the current shipping lanes or in the area of responsibility of the Marine Exchange, send out notifications to all shipping via Notice to Mariners and AIS (once the transmitter is approved by FCC). Provide support letters from all groups to the FCC to allow the Marine Exchange to use the AIS transmitters.
- d. Design and implement procedures that mariners could/would follow that minimize ship strikes (route changes, speed, others). It would be up to the shipping industry to follow them, so the shipping representative would have a lot of work to do.
- e. Once everything is in place, start tracking ships for cooperation and continue tracking the number and location of ship strikes (if any). Revisit the program annually to make changes if needed.
- f. Acquire formal agreement from all parties involved to FUND the above and additional data collection, technology development.

EDC's MSWG proposal

This proposal offers several management options that can be used individually or combined for greater conservation impact. Each of these strategies is something that the working group has discussed in some detail, so we note some of the pros and cons of each, as discussed in forums thus far.

Particularly Sensitive Sea Area (PSSA)

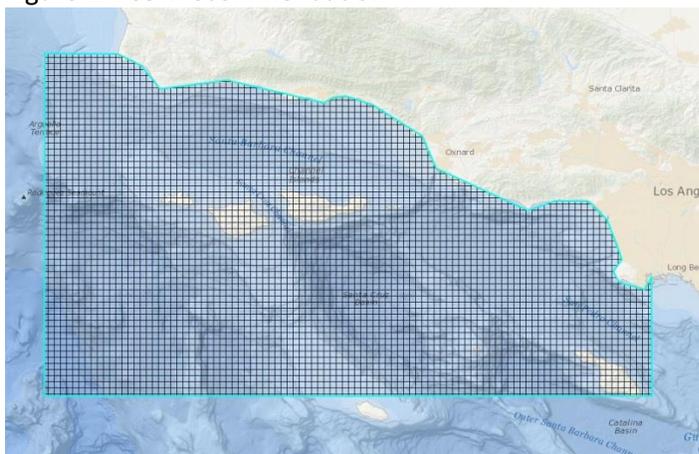
(More information on PSSA can be found here:

<http://www.imo.org/en/OurWork/Environment/PSSAs/Pages/Default.aspx>)

The first management strategy is to create a PSSA, which “is an area that needs special protection through action by IMO because of its significance for recognized ecological or socio-economic or scientific reasons and which may be vulnerable to damage by international maritime activities.”¹ Guidelines for designation include the following: “ecological criteria, such as unique or rare ecosystem, diversity of the ecosystem or vulnerability to degradation by natural events or human activities; social, cultural and economic criteria, such as significance of the area for recreation or tourism; and scientific and educational criteria, such as biological research or historical value.”² The area around the Channel Islands is recognized not for one but all three of the reasons listed by the IMO. It has diverse ecosystems, is vulnerable to human and naturally caused degradation, it has significant recreation and tourism, and it is a well-studied area with baseline data. As we all know, this group was created to discuss one of the resources (whales), which is vulnerable to damage by international maritime activities due to the threat of ship strike. Therefore, we believe this is an excellent fit as one management strategy. Once designated as a PSSA, “specific measures can be used to control the maritime activities in that area, such as routeing measures.”³

The goal of a PSSA in the Channel Islands region would be to protect whales from ship strikes. Therefore, the PSSA would need to be large enough to encompass the area in the SB Channel and to the south of the Channel where ships are transiting to/from the ports of LA/LB. This proposal encompasses the entire study area simply because we want to use this forum to discuss the overall management strategy, not necessarily to determine its physical limits.

Figure 1: PSSA recommendation



¹ <http://www.imo.org/en/OurWork/Environment/PSSAs/Pages/Default.aspx>

² <http://www.imo.org/en/OurWork/Environment/PSSAs/Documents/A24-Res.982.pdf>

³ <http://www.imo.org/en/OurWork/Environment/PSSAs/Pages/Default.aspx>

“An application for PSSA designation should contain a proposal for an associated protective measure or measures aimed at preventing, reducing or eliminating the threat or identified vulnerability.”⁴ The protective measures the PSSA may be associated with could include speed reductions or a routing system. (As per the definition, this route/lane can be specifically created for the protection of the marine environment.) Since the Channel already has a TSS that was recently altered for the protection of whales, this area should already qualify for a PSSA. However, we would like to consider additional management options as well to help further the goals of this working group.

Potential routing systems for this project:

1. Area to be avoided
2. Traffic separation scheme
3. Recommended track

Option 1: Area to be avoided (ATBA)

An expansion of the current ATBA would enhance the area of protection for whales. With concerns for fin whales on the south side of the Channel Islands, an additional ATBA could be created to protect habitat that is predicted to have a high density of whales. Multiple options for the use of ATBAs are listed below. Note: Again, the area drawn is approximate and would be determined using best available data. (Research ideas to improve this area are welcome.)

1. Expand current ATBA to align with the current Santa Barbara Channel TSS. Prior to the recent shift in the south bound lane, the TSS and the ATBA were aligned. However, this boundary was not adjusted to reflect the change and, thus, leaves a gap in protection in the very area determined to be vulnerable to ship strike. This recommendation would simply address an oversight.
2. Expand current ATBA to the west: From Redfern et. al 2013 habitat models, this would protect more habitat that is predicted to have a high density of whales. Input from Calambokidis and Redfern would be requested to ensure the best habitat is encompassed.
3. Expand current ATBA to the south: Same justification as above. The south ATBA boarder is approximate (based on habitat density data in SeaSketch). Input from Calambokidis and Redfern would be requested to ensure the best habitat is encompassed.
4. Create new ATBA south of Channel Islands for fin whale habitat: This is not represented spatially in SeaSketch because we do not have fin whale specific data to work from. The area would be determined using best available data and input from experts.

(Figures on next page)

⁴ <http://www.imo.org/en/OurWork/Environment/PSSAs/Pages/Default.aspx>

Figure 2: ATBA expansion

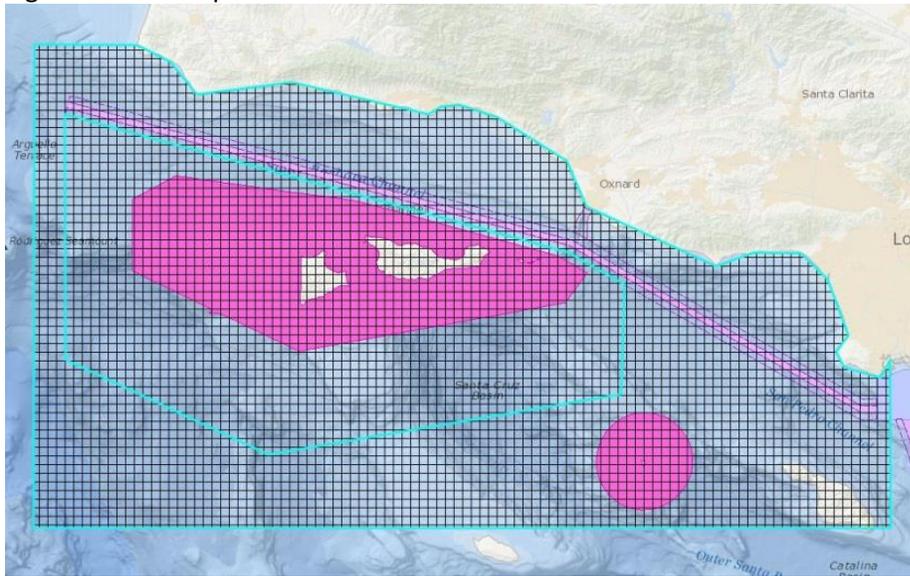
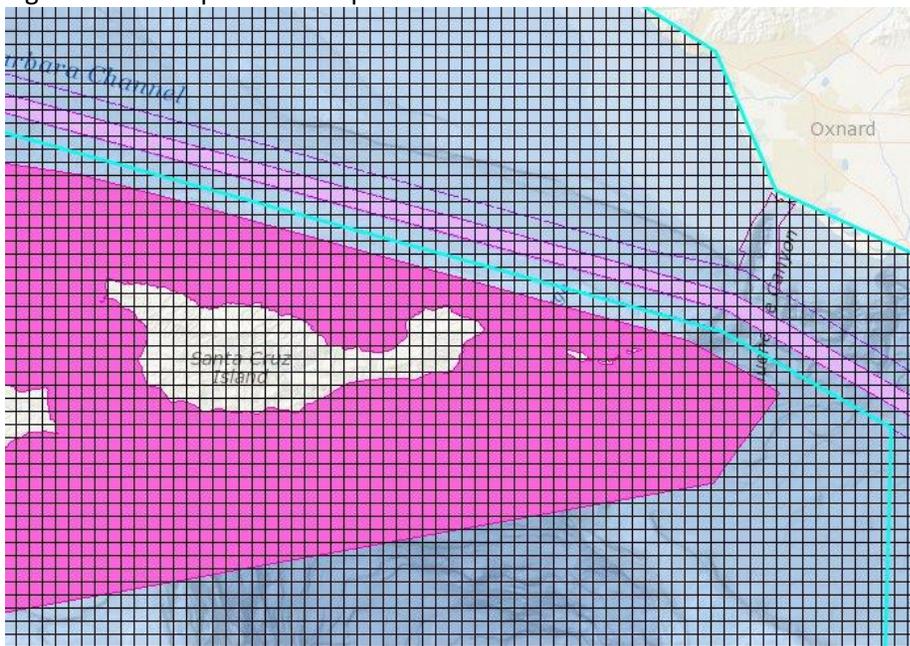


Figure 3: Close up of ATBA expansion near current TSS



Option 2: Speed Reduction

In this spatial proposal, the speed reduction zone encompasses both the SB Channel TSS and area south of the islands. The exact location of the zone to the south of the islands could be limited to a TSS or recommended track, should one be created. The MSWG has had multiple discussions on the merit of a speed reduction zone and we capture some of these discussions in further detail in our description of the specifics of our recommended management strategy, below.

Location of zone: We encompass a large area because vessel traffic is not organized south of the islands. From discussions in our working group meetings, we understand that members are concerned with

threat of ship strike in both the current TSS and in the area south of the Channel Islands (western approach). In the Channel, the zone can be limited to the TSS because this is accepted and used by the shipping industry. The zone is broader to the south of the islands because there is no official organized TSS or recommended track. If one was to put in place, this speed zone could be more limited spatially, though it gets at the same goal.

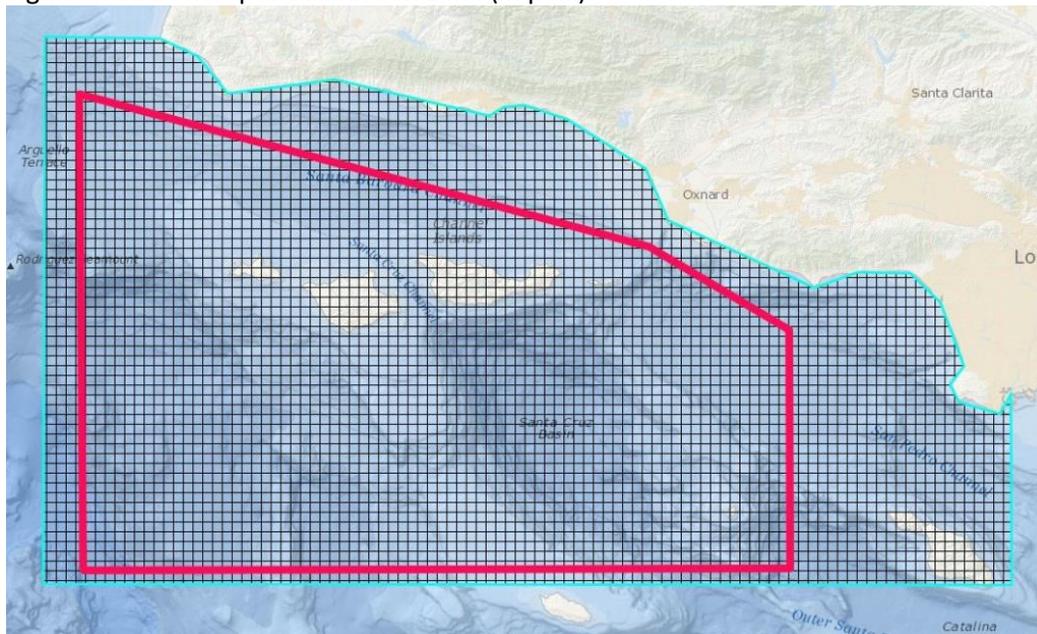
Voluntary vs. Incentive-Based vs. Mandatory: Since voluntary speed reductions have been unsuccessful, a speed reduction program should be incentive based or required through regulation.

Seasonal vs. Dynamic: Seasonal seems to be preferred over dynamic management under current conditions for many reasons, including the following:

1. For air quality, there is a concern that dynamic management is difficult to build into shipping schedules and thus any speed reduction in one area could lead to increased speeds in another area, negating any air quality benefits.
2. Seasonal management could be accomplished without the need for new technologies, whereas new technologies may be required for dynamic management (e.g. AIS upgrades, whale monitoring, etc.).
3. Seasonal has the potential to be easier to communicate at this time to shippers.

Speed: There is scientific evidence that shows a 10 knot speed reduction is more protective of whales, reducing the fatality of ship strikes by 70%, as opposed to the 50% offered by a 12 knot speed.⁵ However, based on information gained in past discussions during the VSR trial program we understand that the navigation of certain sized ships is problematic at such a speed. Therefore, in an effort to compromise we are open to a conversation about a speed reduction to 12 knots. We can provide more information on this recommendation, upon request.

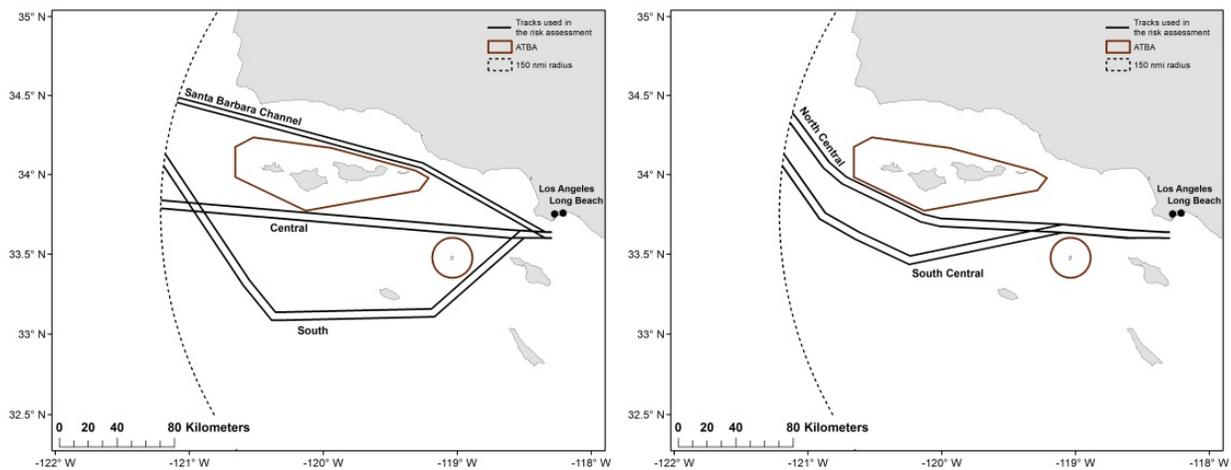
Figure 4: Seasonal speed reduction zone (in pink)



⁵ Vanderlaan and Taggart. 2007. Vessel collisions with whales: the probability of lethal injury based on vessel speed. *Marine Mammal Science*, 23(1): 144-156.

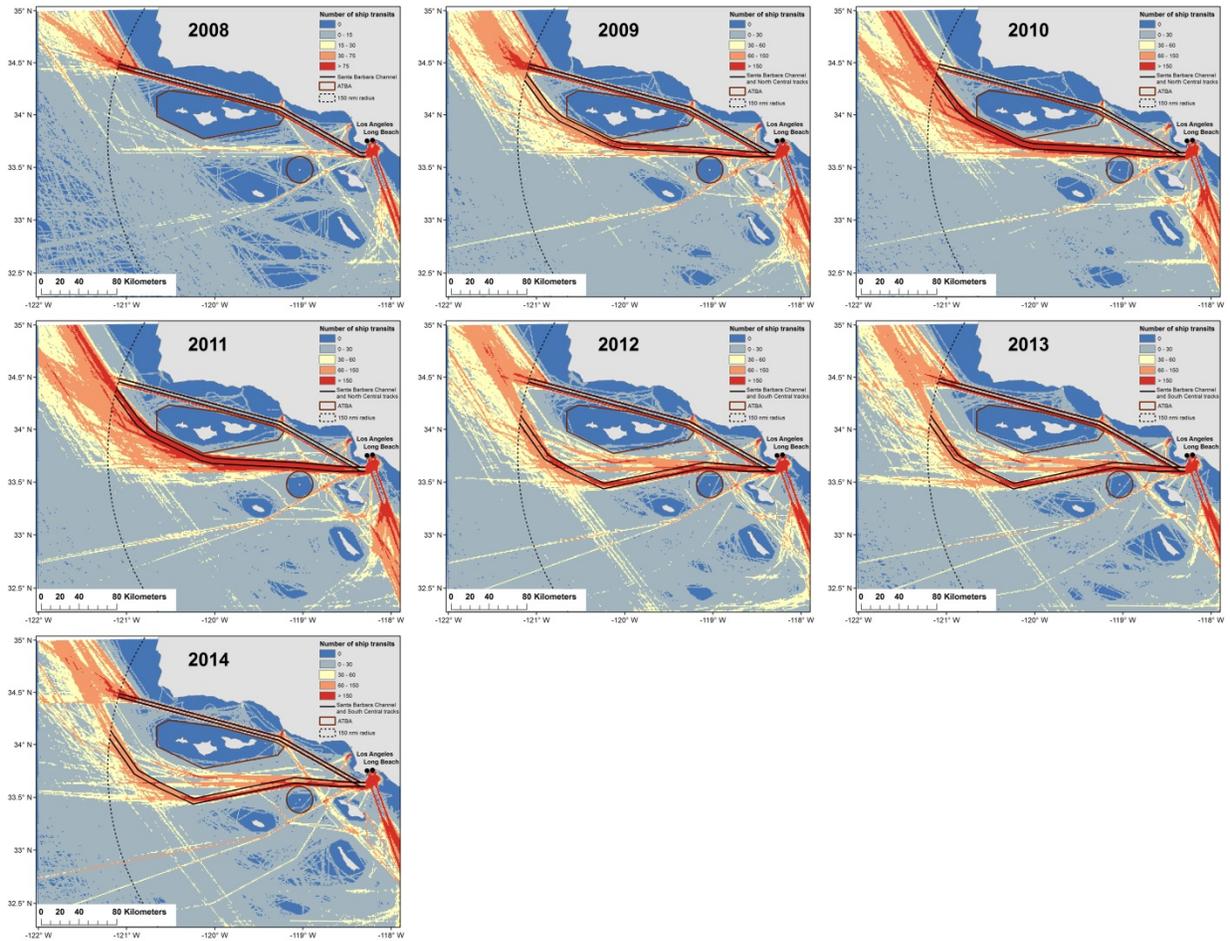
Ship-strike risk in the Southern California Bight

Five ship tracks are analyzed in this risk assessment. All tracks begin at the edge of a circle with a 150nmi radius from the ports; the length of the radius was derived from the extent of the whale density predictions in Redfern et al. (2013). Starting all tracks at this fixed distance from the ports ensures that comparisons among tracks are equitable.

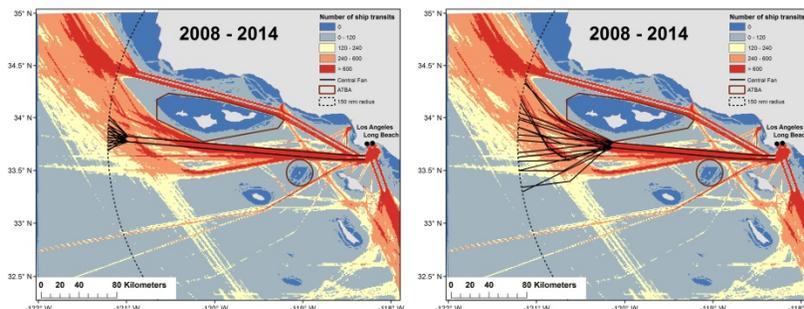


Shipping traffic in the Southern California Bight is dynamic and has shifted multiple times since 2008. Annual maps of shipping traffic (cargo vessels, tankers, and passenger ships with length greater than or equal to 80m) are shown below. The Santa Barbara Channel track overlaps with the official traffic separation scheme (TSS), but is extended to the edge of the circle, and is shown on all traffic maps. As a single track, it is most representative of traffic patterns in 2008 when a majority of ships travelled in the TSS. The North Central track is shown on the 2009, 2010, and 2011 traffic maps and captures the dominant path followed by ships south of the northern Channel Islands. The South Central track is shown on the 2012, 2013, and 2014 traffic maps and captures the dominant path followed by ships south of the northern Channel Islands. The South Central track is very similar to the bathymetry feature avoidance (BFA) option that has been discussed during the working group meetings.

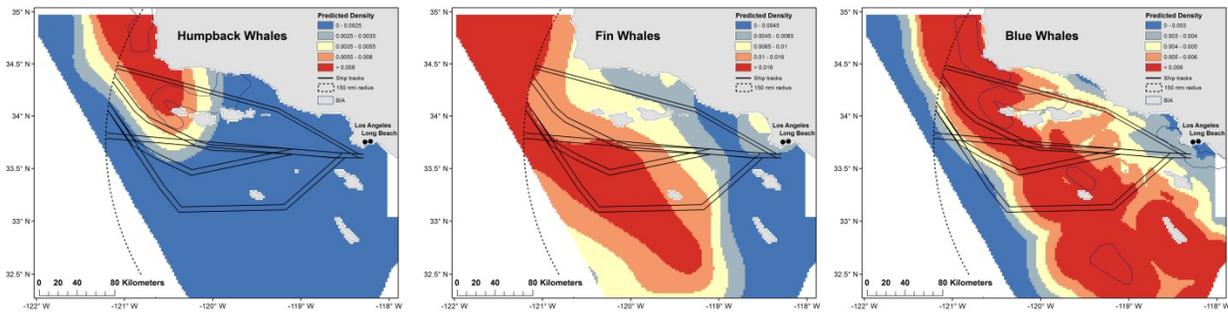
The Central and South tracks do not correspond to primary traffic patterns but do capture areas where ships are known to travel. The Central track was drawn to assess risk in a straight path south of the Islands. It is angled to meet the currently established western voluntary lanes. The South track was drawn to assess risk from ships traveling a far southern path.



We also looked at the possibility of starting the Central track at points inside the circle, instead of on the boundary of the circle. Tracks that start inside the circle are associated with a fan of traffic that captures the paths followed by ships as they enter or exit the track. Fan patterns were derived from 2014 traffic data, but capture traffic patterns observed between 2008 and 2014. The fans are shown below on maps of cumulative traffic between 2008 and 2014. We consider a track that starts at the same radius from the port as the Santa Barbara Channel TSS and a track that starts just below the southernmost point of the area to be avoided (ATBA) associated with the Sanctuary.



Maps of the five ship tracks are overlaid on predicted species densities and Biologically Important Areas (BIAs; Calambokidis et al. 2015) below. Fin whale BIAs have not yet been designated



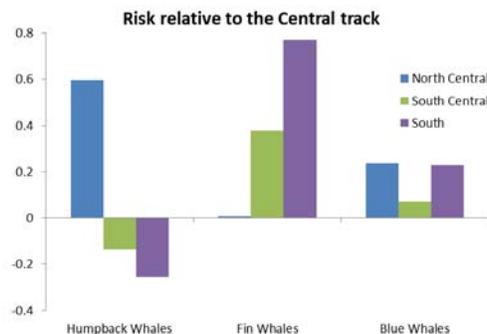
We address the following questions in the risk assessment:

1. What is the optimal track south of the northern Channel Islands?
2. How does risk in this optimal track compare to risk in the Santa Barbara Channel track?
3. How does risk change when we assume all ships travel in Santa Barbara Channel track, all ships travel in the optimal track south of the northern Channel Islands, or ships travel in both the Santa Barbara Channel track and the optimal track south of the northern Channel Islands?
4. How does risk change when ships travel in a fan when entering and exiting the Central track?

Identifying the optimal track south of the northern Channel Islands

To assess the risk associated with each track south of the northern Channel Islands, we summed the number of whales predicted within 0.0338km on either side of the lines representing inbound and outbound traffic. The width on either side of the line was derived from the average of reported vessel beams in our study area during 2014 (i.e., 33.8m). We present the risk relative to number of whales in the Central track.

These analyses show that ship-strike risk south of the northern Channel Islands is lowest in the Central track for fin and blue whales. Risk for humpback whales is higher in the North Central track, compared to the Central track. Risk for humpback whales is lower in the South Central and South tracks, compared to the Central track. However, the decreased risk in these two tracks is not as large as the increase in risk posed to fin whales in these two tracks. Consequently, the optimal track south of the northern Channel Islands is the Central track.



The South Central track in our analyses is similar to the bathymetry feature avoidance option that has been discussed by the working group. The blue whale habitat models developed by Redfern et al. show that the number of blue whales is highest at the 200m isobath. This isobath is a proxy for the shelf edge off southern California and is generally acknowledged to be an important bathymetry feature for blue whales. Risk calculated using the predictions from the habitat models shows that South Central track has a higher risk for blue whales compared to the Central track. This increased risk may be due to the longer length of the South Central track compared to the Central track. It is also possible that features other than bathymetry play an important role in determining offshore blue whale distributions. The habitat models developed by Redfern et al also found strong relationships between blue whales and mixed layer depth and surface chlorophyll concentrations.

Comparing risk north and south of the northern Channel Islands

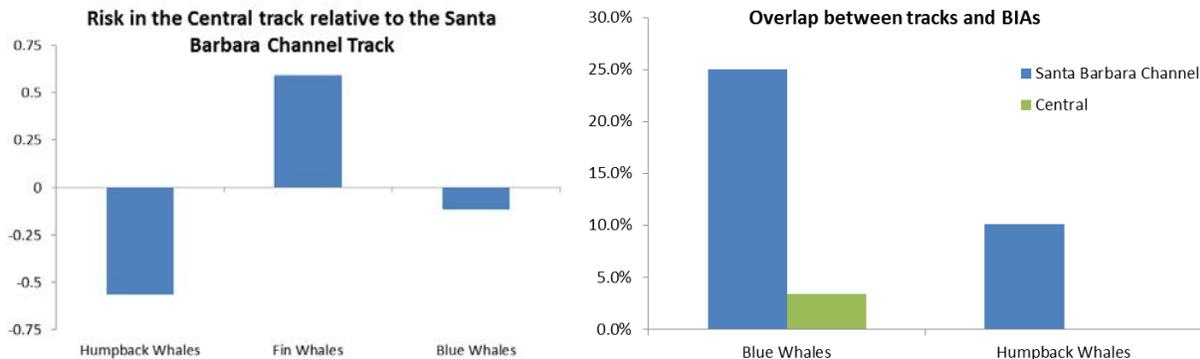
Risk was calculated as above. We present the risk in the Central track relative to risk in the Santa Barbara Channel track. We also calculated the percentage of each track that overlaps with the BIAs.

Similar to the results in Redfern et al (2013), this risk assessment shows that risk in the Central track is lower for humpback and blue whales, compared to the Santa Barbara Channel track. Two additional factors not encompassed in the calculations likely make the central track even more beneficial to blue whales than the Santa Barbara Channel track:

1. Our calculations were limited only to the tracks out to the dashed line shown in the maps, but as can be seen above, the Santa Barbara Channel track ends in an area of highest blue whale density which ships would have to transit through to get to the track, while the central track ends in the lowest density, west of that high density band. While our calculations could not encompass the tracks outside of this area, it is clear that if they did it would magnify the benefit to blue whales of the central track.
2. Our habitat density calculations are based on the more course broad SWFSC surveys. One concern acknowledged in Redfern et al. (2013) is that these do not represent the more fine scale areas of concentration in areas like the Santa Barbara Channel which is more captured by the more extensive and finer scale effort from other sources including Cascadia surveys (as reflected in the BIAs), as well as satellite tag data that shows the western Santa Barbara Channel shipping lanes overlapping with the main concentration of blue whale core areas (Irvine et al. 2014). The high incidence of ship strikes of blue whales in 2007 appeared directly attributed to the very high density overlapping the shipping lanes in the Channel (Berman- Kowalewski et al. 2010). This is a little more captured in the BIA analysis below.

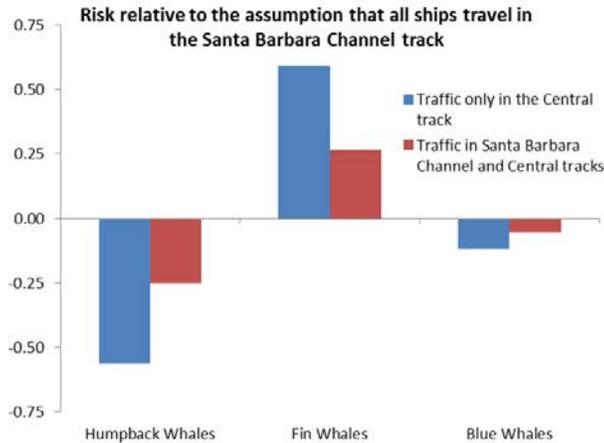
Calambokidis et al (2015) delineated areas containing important feeding areas for blue and humpback whales (BIAs). The Santa Barbara Channel track has a 25% overlap with blue whale BIAs compared to a 3% overlap with the Central track. For humpback whales, the Santa Barbara Channel track has a 10% overlap with their BIAs compared to no overlap with the Central track. Consequently, risk to whales in important feeding areas is higher in the Santa Barbara Channel track compared to the Central track.

One key point about these analyses is that they do not address seasonality of different species. Both blue and humpback whales are present only seasonally (humpback whales generally present in spring through fall and blue whales more present in summer and fall) while fin whales appear to be present more year round (Calambokidis et al. 2014, Douglas et al. 2014). Advantages of the central track versus the Santa Barbara Channel track in terms of risk to whales would be greatest in summer and fall (both blue and humpback whales present) and lowest in winter (mostly fin whales present).



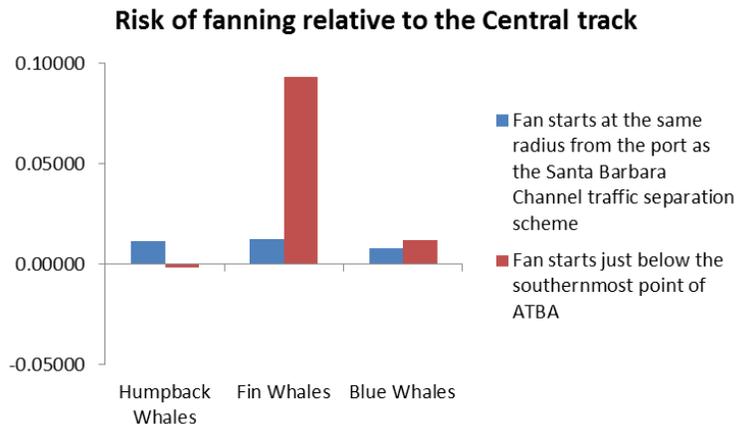
Risk associated with ships traveling both north and south of the northern Channel Islands

All of the above analyses assume that all western and northern traffic to and from the Ports of Los Angeles and Long Beach travels in a single track. In particular, the analyses above assume that 908 vessels arrive at and 816 vessels depart from the ports; the number of arrivals and departures were derived from August to November 2014 MX SoCal data (Kip Loutitt). The MX SoCal data can also be summarized according to whether ships traveled north or south of the northern Channel Islands. We used these data to consider a scenario in which traffic traveled in the Santa Barbara Channel track and the Central track. Specifically, we assumed that 511 vessels arrived and 441 vessels departed from the Santa Barbara Channel track and 397 vessels arrived and 375 vessels departed from the Central track. We present previous results for the risk in the Central track relative to risk in the Santa Barbara Channel track and risk when ships travel in both the Santa Barbara Channel and Central track relative to all ships traveling in the Santa Barbara Channel track. These results show that relative risk is intermediate for all species (i.e., the decrease is not as large for humpback whales and the increase is not as large for fin whales) when traffic travels both north and south of the northern Channel Islands.



Risk associated with ships traveling in a fan when entering and exiting the Central track

We assessed risk in fanning patterns associated with a Central track that starts at the same radius from the port as the Santa Barbara Channel TSS and a Central track that starts just below the southernmost point of the ATBA. Risk generally increases when ships travel in a fan pattern as they enter and exit the Central track. The increase in risk is much higher for fin whales when the fan extends farther eastward (i.e., to the southernmost edge of the ATBA). There is considerable uncertainty about the path that ships would take to approach a Central track that begins farther eastward. However, it remains likely that risk would increase for fin whales on more eastward tracks because many ship paths south of the northern Channel Islands overlap with areas predicted to have high densities of fin whales.



Species considerations

Some of the analyses suggest potential trade-offs between some large whale species. Below we identify some considerations in evaluating risk and benefits to different species:

- While our calculations compare risk based on occurrence of whales, they do not reflect any differences in susceptibility of different species to being struck. Based on direct monitoring of blue whales in close encounters with ships (McKenna et al. 2015), blue whales appear to engage in only limited avoidance of ships potentially making them more

susceptible to ship strikes than other species. This also appears reflected in the high proportion of strandings of blue and fin whales that are associated with ship strikes compared to other species (Douglas et al. 2008).

- Humpback and fin whale abundance has been increasing off the US West Coast while that of blue whales has been stable (based on photo-ID mark recapture) or even declining (based on line-transect estimates from the 1990s to more recent years) (Calambokidis and Barlow 2004, 2013). The reason for blue whales not increasing has been debated in recent years especially in light of a recent analysis that suggested blue whale abundance may never have been high in this region and may already be back at historical pre-whaling numbers.
- Overall abundance of fin whales is higher than for blue whales. Both species are still listed as endangered under the ESA. Humpback whale overall abundance in the North Pacific in the mid 2000s was estimated at around 20,000 but the distinct feeding areas off California and Oregon numbers about 2,000 (Barlow et al. 2011, Calambokidis et al. 2008, Calambokidis and Barlow 2013). NOAA has proposed recognizing separate humpback whale breeding area Distinct Population Segments (DPS) under the ESA and delisting the Mexico DPS but recognizing the Central America DPS as threatened. Southern California represents the primary feeding areas for humpback whales breeding in Central America (Calambokidis et al. 2000, 2008).

Literature cited

- Barlow, J., Calambokidis, J., Falcone, E. A., Baker, C. S., Burdin, A. M., Clapham, P. J., Ford, J. K. B., Gabriele, C. M., LeDuc, R., Mattila, D. K., Quinn, T. J., Rojas-Bracho, L., Straley, J. M., Taylor, B. L., Urbán R., J., Wade, P., Weller, D., Witteveen, B. H. and Yamaguchi, M. 2011. Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. *Marine Mammal Science* 27: no. doi: 10.1111/j.1748-7692.2010.00444.x
- Berman-Kowalewski, M., F.M.D. Gulland, S. Wilkin, J. Calambokidis, B. Mate, J. Cordaro, D. Rotstein, J. St. Leger, P. Collins, K. Fahy, and S. Dover. 2010. Association between blue whale (*Balaenoptera musculus*) mortality and ship strikes along the California coast. *Aquatic Mammals* 36: 59-66.
- Calambokidis, J. and J. Barlow. 2013. Updated abundance estimates of blue and humpback whales off the US West Coast incorporating photo-identifications from 2010 and 2011. Final Report for contract AB-133F-10-RP-0106. PSRG-2013-13R. 8pp.
- Calambokidis, J., G.H. Steiger, K. Rasmussen, J. Urbán R., K.C. Balcomb, P. Ladrón de Guevara P., M. Salinas Z., J.K. Jacobsen, C.S. Baker, L.M. Herman, S. Cerchio and J.D. Darling. 2000. Migratory destinations of humpback whales that feed off California, Oregon and Washington. *Marine Ecology Progress Series* 192:295-304.
- Calambokidis, J., E.A. Falcone, , T.J. Quinn, A.M. Burdin, P.J. Clapham, J.K.B. Ford, C.M. Gabriele, R. LeDuc, D. Mattila, L. Rojas-Bracho, J.M. Straley, B.L. Taylor, J. Urbán R., D. Weller, B.H. Witteveen, M. Yamaguchi, A. Bendlin, D. Camacho, K. Flynn , A. Havron, J. Huggins, N. Maloney, J. Barlow, and P.R. Wade. 2008. SPLASH: Structure

of Populations, Levels of Abundance and Status of Humpback Whales in the North Pacific. Final report for Contract AB133F-03-RP-00078 prepared by Cascadia Research for U.S. Dept of Commerce. May 2008.

- Calambokidis, J, GH Steiger, C Curtice, J Harrison, MC Ferguson, E Becker, M DeAngelis, and SM Van Parijs. 2015. Biologically Important Areas for Selected Cetaceans Within U.S. Waters – West Coast Region. *Aquatic Mammals* 41(1), 39-53. DOI 10.1578/AM.41.1.2015.39
- Campbell, G.S., L. Thomas, K. Whitaker, A.B. Douglas, J. Calambokidis, and J.A. Hildebrand. 2014. Inter-annual and seasonal trends in cetacean distribution and abundance off southern California. *Deep-Sea Research II*. <http://dx.doi.org/10.1016/j.dsr2.2014.10.008>
- Douglas, A.B., J. Calambokidis, S. Raverty, S.J. Jeffries, D.M. Lambourn, and S.A. Norman. 2008. Incidence of ship strikes of large whales in Washington State. *Journal of the Marine Biological Association of the United Kingdom* 88:1121-1132.
- Douglas, A.B., J. Calambokidis, L.M. Munger, M.S. Soldevilla, M.C. Ferguson, A.M. Havron, D.L. Camacho, G.S. Campbell and J.A. Hildebrand. 2014. Seasonal distribution and abundance of cetaceans off southern California estimated from CalCOFI cruise data from 2004 to 2008. *Fishery Bulletin* 112:197-220. doi: 10.7755/FB.112.2-3.7
- Irvine L, Mate B, Winsor M, Palacios DM, Bograd SJ, Costa DP, Bailey H. 2014. Spatial and Temporal Occurrence of Blue Whales off the U.S. West Coast, with Implications for Management. *PLoS ONE*. 9(7)
- McKenna, M.F., J. Calambokidis, E.M. Oleson, D.W. Laist, and J.A. Goldbogen. 2015. Simultaneous tracking of blue whales and large ships demonstrates limited behavioral responses for avoiding collision. *Endangered Species Research* 27 (3):219-232. doi:10.3354/esr00666
- Redfern, J. V., M. F. McKenna, T. J. Moore, J. Calambokidis, M. L. DeAngelis, E. A. Becker, J. Barlow, K. A. Forney, P. C. Fiedler, and S. J. Chivers. 2013. Assessing the risk of ships striking large whales in marine spatial planning. *Conservation Biology* 27:292-302.

Suggestions for Analysis by the CINMS Marine Shipping Working Group

Greg Silber

August 2015

Speed restrictions based on acoustic (or other) whale detections

- In a pre-determined area surrounding the entire Channel Islands, LA/LB complex, deploy an array of bottom-mounted passive acoustic listening devices. This might entail something like 10-20 sensors laid out in a large grid.
- Then, when whales (of *any* species) are detected (by *any* of the sensors, at any time), ships would *automatically be required* to travel at [some specified speed, *e.g.*, 10 or 12 knots] throughout the entire area for a period of [some specified time, *e.g.*, 24 hours] from the time of the detection. The period would be extended with each new detection.

Background/Justification

There seems to be two thoughts/concerns expressed by some members of the Working Group. One is “tell us when the whales are present -- then we’ll respond”. And, some indicate there are insufficient historic data on whale distribution. This option would address both.

Detecting whales from aircraft is expensive and incomplete (time aloft is limited by darkness and poor weather). Developing an extensive listening array would provide a reliable (operating 24/7/365) and cost-effective method for whale detection, although up-front costs would be high.

Even though it addresses the interest in “tell us when the whales are present...”, this alternative is dynamic and would introduce considerable unpredictability and presumably added cost (due to missed or delayed schedules) into shipping schedules. Another downside is that some whale calls, blue and fins whales notably, can propagate great distances; and the listening system would not have directionality, so identifying *specific* whale locations likely would not be possible. Therefore, it will not always be clear if whales are in the immediate vicinity. Nonetheless, those limitations, reflected in blanket speed restrictions, would provide added safeguards for whales.

There are advantages. The listening system would provide continuous data accumulation on (seasonal) whale occurrence. The program could also be ‘tuned’ in various ways. For example, the size of the area around a detecting sensor that prompts a speed restriction could be expanded or contracted (a five-mile diameter would be a reasonable starting point). The required vessel speed could be tweaked (*e.g.*, 10, 12, 15 knots) to lessen economic impact. If triangulation of whale calls could be added, then smaller, more specific speed restriction areas could be incorporated.

This measure would likely require domestic rulemaking, a process that might take several years to complete. But, an economic analysis precedent exists that might be useful (Nathan Associates, 2012 http://www.nmfs.noaa.gov/pr/pdfs/shipstrike/economic_analysis_dec2012.pdf) in assessing this option.

[*Please note:* Kathy and others have suggested that an approach such as this might also rely on a network of detection systems folded together that might also include aircraft surveys, ‘whale alert’ apps, and vessel-based (*e.g.*, thermal imaging) detections. While I believe there are a number of problems with using these methods, they are certainly worth considering.]