APPENDIX MS2013-06. SCENARIOS FOR SHIPPING ON THE US WEST COAST

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INTRODUCTION

As an integrated synthesis of the marine ecosystem in the California Current, the IEA focuses on five components: habitat, wild fisheries, ecosystem integrity, vibrant coastal communities, and protected resources (Levin and Schwing 2011, Levin et al. 2013). Drivers and pressures on these components that are within the scope of the IEA include:

- Shipping
- Freshwater habitat loss or degradation
- Coastal zone development
- Fishing
- Invasive species
- Naval exercises
- Aquaculture
- Energy development
- Marine habitat disturbance
- Oil spills
- Climate change

Notably, shipping is potentially linked to other pressures such as coastal zone development (via dredging and construction of terminals), invasive species (via ballast water), energy development (for instance to transport oil or coal), naval exercises (that alter shipping routes), and oil spills. Protected species such as whales and turtles may be struck by ships, and both the overlap of species' habitat use with shipping routes (Redfern et al. 2013), and shipping speeds (Vanderlaan and Taggart 2007) may determine the frequency of ship strikes. Concern regarding risk of oil spills to sensitive marine species and ecosystems led NOAA, working with the U.S. Coast Guard, to request that the International Maritime Organization (IMO) designate 'an Area to be Avoided' by certain classes of ships off the Olympic Coast National Marine Sanctuary [1]. NOAA also worked with the U.S. Coast Guard and the IMO to create recommended lanes for ships carrying hazardous materials, which increased the distance that ships are to stay offshore when within Monterey Bay National Marine Sanctuary[2]. To reduce the risk of ships striking whales, NOAA provided the U.S. Coast Guard with information which they considered in their proposals to the IMO to modify the traffic separation schemes at the approaches to the Ports of Los Angeles/Long Beach and San Francisco. The traffic lane changes included measures to reduce the risk of ship strikes, such as moving vessel lanes away from known locations of whale aggregations[3]; these changes were adopted by the IMO in 2012 and went into effect June 1, 2013.

Figure 1. Container ships. Photo: NOAA

1 http://olympiccoast.noaa.gov/protect/incidentresponse/atba.html)
2 http://montereybay.noaa.gov/vt/vtexec.html
3 http://sanctuaries.noaa.gov/protect/shipstrike/policy.html

Arguably, the 2011-2012 IEAs focused more on fishing than shipping, though these ecosystem assessments do include time series of shipping volumes and tonnage beginning in 2003, and dredge volumes from 1997. One clear indication of the intersection between shipping, protected species, fisheries, and energy development was the work of Plummer and Feist (*in* Levin and Wells (2013)), which illustrated potential spatial conflicts between sites for wave energy and other uses, such as tug-and-barge lanes, critical habitat for green sturgeon, and fishing areas for Oregon fleets.

One of the goals of the IEA is to evaluate the performance of management strategies, in terms of outcomes for ecosystem components (e.g. a protected species or fish) that are influenced by the set of drivers and pressures above. To lay the groundwork for future quantitative models that may include shipping, we conducted a series of conversations with eight individuals familiar with the shipping industry. The goal was to understand recent and potential future trends in US West Coast shipping sectors over the next 5-30 years. Below, we outline five of these trends, which are simple scenarios that are relevant to understanding or predicting shipping routes, speeds, or volumes, and may be relevant in predicting effects of shipping on various components of the ecosystem.

INTENDED AUDIENCE

This summary is intended for IEA researchers who wish to consider how their research, and components of the California Current Ecosystem, fit into the context of West Coast shipping. It is targeted for fishery biologists, social scientists, and others who want a simple entrée into some of the issues driving trends in shipping. It aims to illustrate the issues and potential future trends.

METHODS

The methodology was a series of informal conversations via telephone. These conversations do not constitute formal interviews or scoping. Respondents were free to focus on shipping sectors with which they were most familiar. Initial contacts were recommended by staff from the Office of National Marine Sanctuaries (ONMS) familiar with San Francisco ship traffic; most respondents recommended additional contacts or documents. In a few cases we have supplemented responses with citations from published literature.

We present the results of the conversations as very simple scenarios, similar to those developed for other marine sectors in the 2012 California Current IEA (see Levin and

Wells (2013)). Scenario planning is one highly effective means of creating sensible and powerful narratives that help stakeholders envision the future, and help modelers specify meaningful measures of pressure on the ecosystem. Scenario planning has been applied to environmental issues for over 40 years (Alcamo 2008). Recently the Millenium Ecosystem Assessment (2005) successfully used scenario development to envision plausible future states for the global environment and human populations. As described in the Millenium Ecosystem Assessment, scenarios are “plausible and often simplified descriptions of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces and relationships.” Ash et al. (2010) note that “an important function of scenario analysis—particularly in the context of ecosystem assessments—is that it provides an approach to reflect on and think through the possible implications of alternative decisions in a structured manner. Simply put, a scenario exercise offers a platform that allows [decision makers] to reflect on how changes in their respective context (that is, developments not within their immediate spheres of influence) may affect their decisions.” The preliminary scenarios below aim to provide that context for shipping and components of the California Current ecosystem.

The eight respondents offered insights from a:

- Global shipping company
- Non-profit organization on clean transportation
- US West Coast shipping trade association
- National shipping trade association
- US West Coast tug-and-barge trade association
- Port operating association
- NOAA National Marine Fisheries Service
- NOAA National Ocean Service

A grasp of the different shipping sectors that exist on the US West Coast is useful in understanding the responses. Container ships (**Figure 1**) transport dry freight in modular shipping containers. Common routes are from China or Southeast Asia to major US ports such as LA/Long Beach, San Francisco/Oakland, Seattle/Tacoma, Vancouver and Prince Rupert Canada, and Ensenada Mexico. Tankers and barges carry liquid cargos including crude oil and refined petroleum products, for instance from Alaska to refineries in Puget Sound or San Francisco Bay. Bulk freight is dry freight that is not carried in containers, such as grain, coal or wood products, which are often exports from North America. Tug-and-barge traffic involves transport of a variety of goods both on the open ocean, in Puget Sound and San Francisco Bay, and in the Inside Passage to Alaska. Tugs also are essential for assisting larger vessels in port.

RESULTS

SCENARIO 1: HIGH FUEL PRICES SUSTAIN SUPER SLOW STEAMING, BUT DO NOT SPARK SHORT-SEA SHIPPING

Increases in fuel prices were noted to have already changed shipping patterns over the last 10 years. Super slow steaming, meaning reducing ship speeds from maximum (e.g. 25 knots) to most efficient (e.g. 17 knots) speeds was discussed as common practice, with the exact speed varying by ship and engine type. Container ships, bulk freighters, and tankers were all reported to have adopted this practice. Slower steaming may necessitate using more ships in rotation, but reduces fuel consumption that accounts for 60% of variable costs. Slower speeds were also reported as one way to improve compliance with emissions regulations. Slower ship speeds were mentioned as one response to the economic downturn of 2007-2008, low consumer demand for goods during that period, and excess capacity in the shipping fleet. Though there is some potential that ship speeds might increase with an increase in consumer demand, the consensus was that slower, more efficient speeds will likely remain common practice for the long term for container and liquid cargo vessels. One respondent noted that tugs and-barges already have low speeds (7-10 knots) and high fuel efficiency per ton of cargo. The continuation of slower speeds for large ships could be relevant to predicting risk and severity of mammal-ship strikes (Vanderlaan and Taggart 2007).

Short-sea shipping, which is the transport of goods via ship between US ports, has been suggested as one response to higher fuel costs for land transportation (Perakis and Denisis 2008). However, respondents noted that success with this was limited on the West Coast. One respondent noted that there was limited capacity for US shipyards to provide appropriate vessels, and that short-sea shipping ran counter to economies of scale (see below); another respondent noted that heavy subsidies were required to initiate short-sea shipping efforts in California. Increased handling cost (unloading each container twice, once from a trans-Pacific ship and once from a coastal ship) was cited as a major economic obstacle.

SCENARIO 2: ECONOMIES OF SCALE PUSH FOR FEWER, LARGER SHIPS CONCENTRATING IN THE LARGEST PORTS

Respondents familiar with the container ship and tanker sectors noted large increases in ship size over the last decade, in an effort to maximize economies of scale and reduce cost per unit of cargo. Thus, we may expect diverging trends between indicators of vessel counts and cargo volume, both of which have been reported in the IEA. A respondent noted that one exception is for tankers in Puget Sound, where tanker size is capped at 125,000 tons, necessitating more transits of smaller tankers. Relatively weak economic demand was cited as one reason why mid-sized vessels are being scrapped or sold earlier than is typical, to be replaced by larger ships. Widening of the Panama canal (see below) also allows larger ships in general, but the global trend toward larger vessel size has been ongoing for thirty years (Cullinane & Khanna 2000). Continuing this trend toward fewer, larger vessels would likely favor the use of the largest ports, such as LA/Long Beach (**Figure 2**) (see also Redfern et al 2013). Shipping impacts on the ecosystem would likely be concentrated on these ports. Limitations on federal infrastructure investment, compared to European ports, was mentioned as one limit to handling increased numbers of the largest vessels, and to further expansion of the largest ports at the expense of the smallest.

Predicting impacts of shipping on marine resources might require tracking different indicators of shipping activity. For instance, risk of marine mammal ship-strikes or likelihood of oil spills may depend on ship transits, while the potential scale of oil spills may depend on liquid cargo and fuel volumes.

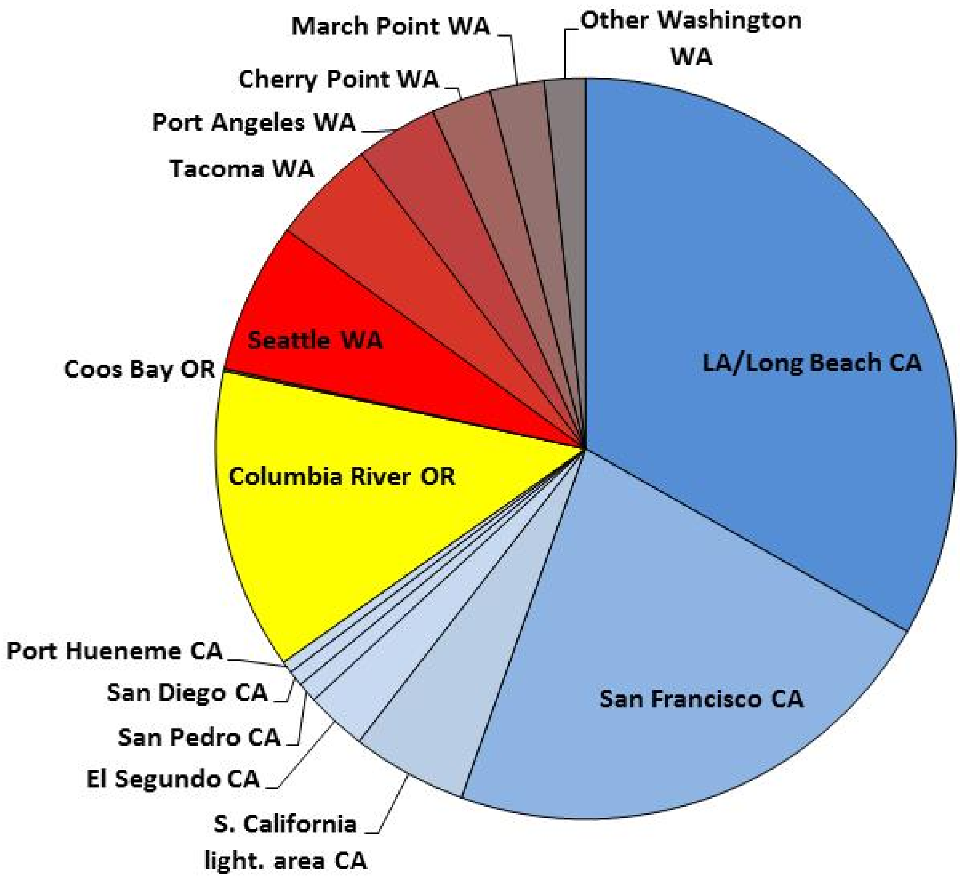

Figure 2. 2011 US West Coast Vessel traffic, proportion of deadweight tonnage x vessel calls, provided by the US Department of Transportation. Includes vessels over 10,000 deadweight tons.

SCENARIO 3: WIDENING OF PANAMA CANAL SHIFTS CONTAINER TRAFFIC FROM WEST COAST TO EAST.

The Panama Canal is being expanded, with a new set of locks and capacity for larger ships slated for 2015. Goods manufactured in Asia, transported in containers, and destined for the US East Coast or Midwest will be able to travel via the canal directly to the East and Gulf Coasts on the largest ships. This may make the canal route more cost efficient than for instance unloading in LA or Seattle, and sending goods east by rail or truck. Respondents mentioned that roughly 70% of freight into Seattle, and 50% into LA/Long Beach, is headed to consumers to the east. The most extreme outcome would be a scenario with a 50% decline in container ship traffic to West Coast ports. Impacts from shipping on the marine environment, or conflicts with other marine sectors, would likely decline near major container ship ports such as LA/Long Beach, San Francisco/Oakland, Tacoma, and Seattle.

However, respondents noted multiple reasons to doubt that the widened canal would cause a broad decline in West Coast shipping. Firstly, they noted that a substantial portion (perhaps half) of goods unloaded on the West Coast are non-discretionary, meaning that they are consumed on the West Coast. Secondly, recent major port infrastructure improvements linking ships to rail and truck service were said to make West Coast ports more cost-competitive. In contrast, East Coast ports must be deepened to allow access to the largest ships when they are fully loaded, and ports such as Jacksonville, Charleston, and Savannah were said to be competing for limited federal funds for dredging. Finally, a shift in manufacturing from China to Southeast Asia and India already favors shipping goods west, through the Suez Canal, and so further declines in east-bound traffic may be unlikely with the 2015 opening of the wider canal.

SCENARIO 4: CLEAN FUEL REQUIREMENTS CONTINUE TO ALTER SHIP ROUTES, ENCOURAGE SLOW-STEAMING

In June 2008, the State of California Air Resources Board (CARB) adopted a regulation that required the use of low sulfur fuel (clean fuel) in large vessels when traveling within 24 nautical miles of the coast. The regulation was designed to reduce particulate matter, oxides of nitrogen and sulfur oxide emissions. The initial CARB rules resulted in shifts in ship travel patterns as many ships moved farther offshore, rather than travel in established traffic separation zones (e.g., Santa Barbara Channel (McKenna et al. 2012, Redfern et al. 2013)), in order to avoid the cleaner fuel requirement within 24 nautical miles. The IMO sets emissions standards for ships internationally through the International Convention on the Prevention of Pollution from Ships, also known as MARPOL. Under MARPOL the IMO established emissions control areas (ECAs) where stringent limits on emissions are imposed and low-sulfur fuel requirements are being phased in over the next several years. The North American ECA includes most of the U.S. and Canadian Exclusive Economic Zones (i.e. within 200 nautical miles of the coast). By 2015, ships operating in the North American ECA must use fuel with sulfur content of 0.1%. The requirements for clean fuel use out to 200 nautical miles could eliminate the advantage of these routes that were slightly offshore of 24 nautical miles. In such a scenario, a change in shipping routes would lead to changes in the overlap with habitat use by particular whale species. For instance, Redfern et al. (2013) found that humpback whales in Southern California occur in nearshore areas, while fin whales occur farther offshore.

Increased fuel efficiency is mandated for all new ships by the IMO under the Energy Efficiency Design Index (EEDI) requirements, and two respondents indicated that this could also encourage the continuation of slower, more efficient steaming speeds.

To the extent that air quality regulations are already in place, there may be limited further impacts on ship routes, but additional Tier III requirements under the IMO could require further reductions in emissions, or installation of potentially costly Selective Catalytic Reduction Systems. Vessels that spend the majority of time within 200 nm, such as cruise lines or coastal freighters serving Alaska, may switch to LNG fuel to meet emissions requirements, while larger ships may alter routes.

SCENARIO 5: NORTH AMERICAN ENERGY DEVELOPMENT INCREASES TANKER AND BULK FREIGHT EXPORTS FROM THE PACIFIC NORTHWEST

The ongoing development of new sources of oil, natural gas, and coal throughout the US and Canada may lead to large increases in tanker and bulk freight cargos from ports in Oregon, Washington, and the Vancouver Canada area. For instance, one respondent familiar with the region pointed out that coal terminals are proposed or under review in Puget Sound, the Vancouver BC area, and on the Columbia River. The proposed Gateway Pacific coal terminal would result in approximately 487 freighters in Puget Sound annually (~15% increase in vessel traffic), while the Kinder-Morgan Pipeline from Alberta could result in an additional 358 tankers through the Strait of Juan de Fuca[4]. Respondents noted potential for export of US shale oil from the Dakotas via rail, to Pacific Northwest ports. They also noted that this export of energy was occurring at a time when US consumer demand for refined gasoline was falling, and production of crude oil on the North Slope of Alaska and tanker traffic between Alaska and the West Coast states, were declining.

[4] www.seas.gwu.edu/~dorpjr/VTRA/PSP/June13/1%20-%20VTRA%202010%20%20-%20PGHSC%20JUNE-%20WHAT%20IF%20SCENARIO%20SIMULATION.pdf

OTHER FACTORS

Arctic ice melting allows increased ship traffic to Alaska:

Smith and Stephenson (2013) and others note that global climate models suggest that melting ice could allow increased shipping activity in the Arctic, with regular use of the Northwest Passage by mid-century. Most respondents were skeptical of this, or considered the timeframe to be too great for speculation. Moreover, seasonal unpredictability of trans-Arctic routes could make any commercial transit unreliable for modern shipping networks. One respondent identified a major exception to this: destination trips, for instance trips by small fuel tankers or tugs to service oil installations in Alaska. Such vessels may be based in Washington and this may lead to modest increases in West Coast traffic.

Competition between US and Canadian and Mexican ports

Competition between US ports and Canadian and Mexican ports was mentioned by port and shipping company representatives. In particular, competition for importing discretionary goods (those not consumed locally) by Vancouver and Prince Rupert Canada was cited as a major concern for Pacific Northwest ports. As discussed above, export of new energy sources (coal, oil, LNG) could occur from a variety of ports in Washington and British Columbia. Development of freight capacity in Ensenada, Mexico could shift traffic away from LA/Long Beach. Lower port fees and infrastructure were the major advantages for Mexican and Canadian ports. Given the proximity of these Canadian and Mexican ports to US waters, a shift in traffic to these ports might still involve risks from vessels transiting or operating near the US portion of the California Current.

CONCLUSION

The scenarios above may serve as catalysts for future quantitative analysis and predictive modeling through the IEA. Though the five scenarios are preliminary and intentionally broad, they could be refined into quantitative predictions relevant to particular management questions for protected resources, fisheries, habitat, ecosystem integrity, and coastal communities. The details of refined scenarios would depend upon the geographic, temporal, ecological, and social scope of models available for such management questions. For instance, concerns about risk to herring spawning habitat in Puget Sound would require quite a different scenario specification than consideration of marine mammals and shipping lanes in Southern California.

The ideas presented here are not novel, and experts have presented detailed scenarios and quantitative predictions of shipping patterns on the global scale. For instance, Tavasszy et al. (2011) considered global and European perspectives on scenarios involving super slow steaming, increased costs of land transportation, and increased use of Arctic routes. Tavasszy and colleagues predicted that super slow steaming would favor larger container ships and ports that were equipped to handle transhipments (i.e. hubs in distribution networks). Doubling land transportation costs was predicted to shift 8% more traffic to ports and shipping, including short sea shipping. Polar routes were predicted to absorb as much as 1.5% of container ship traffic, but would be particularly relevant to northern ports. A separate global scenario planning exercise for shipping was undertaken by Wartsila, the Finnish manufacturer of large marine engines and other equipment[5]. The authors of that exercise envisioned three complex scenarios: Rough Seas, Yellow River, and Open Oceans. These involve broad narratives about the location of key industries, economic development, required shipping routes and demand by ship type, and national and international responses to challenges such as climate change and piracy. For the California Current IEA, the aim is not to duplicate these efforts, but to understand how these global forces translate into impacts on local ecosystem components and ecosystem-based decision making.

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