

**Analyzing Vessel Interactions Surrounding Southern Resident
Killer Whales (*Orcinus orca*)- Summer 2011**

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Marine Research Apprentice
Fall 2011

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Key Words: *Orcinus orca*, Cetacea, Vessel, Endangered Species Act

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Abstract

As global biodiversity continues to decline greater attention is being paid on ways law can be a mechanism to advance conservator efforts. Currently, southern resident killer whales are listed as 'endangered' under the endangered species act. Comprising a population of 88 individuals it has been shown that disturbance by vessels may affect key behaviors and mask echolocation, which is critical for foraging and communication. Within the Puget Sound, Southern Residents are exposed routinely to commercial whale watching, and vessel interaction has been listed as a contributing factor to their endangered status. The National Oceanic and Atmospheric Administration implemented federal vessel regulations in April 2011 with include a no parking in the path of whales' restriction and a 200-yard buffer between vessels and whales. Within May through September 2011 Soundwatch collected data pertaining to the number of vessels, the types of these vessels, and any observed incidents. What was found that on average 12 boats surround this population on a daily basis, with a maximum of 62 boats. These boats mostly comprise of commercial whale watching operations with 6 boats on average. Of the 2,500 incidents that were private boaters committed 58%, followed by the commercial industry with 21%. The top incidents that were committed were being within 200 yards and 100 yards of the whales, and being inshore of whales. As NOAA seeks to revise and enforce these federal regulations it is imperative to have accurate and consistent monitoring on the water.

Introduction

Although great emphasis has been placed on global biodiversity decline not much attention has been paid to increasing Endangered Species Act success rates. Within the scope of my study I hope to understand real world influences the ESA can have on endangered killer whales. In April 2011 the National Oceanic and Atmospheric Administration released the first federal law on vessel activity surrounding killer whales. Increased boater activity around killer whales has been proven to elicit negative responses such as increased swimming rates and acoustic behavior. By analyzing vessel trends, and vessel density we can begin to understand the daily trends associated with ecotourism on an endangered population.

Review of the Literature

Globally biodiversity is continuing to decline at an exponential rate. (Swanson 1998) This has resulted in many scientists, policy makers, and organizations attempting utilize law as a mechanism to protect keystone species, and critical habitats. One of the primary tools to advance conservation efforts of both marine and terrestrial species is the Endangered Species Act. Since being enacted in 1973 the ESA has listed 1,852 plant and animal species and delisted 51. This gap between recognizing a species is in threat of extinction and full recovery has left many people questioning way's to improve the ESA process. Within my study I hope to understand some components that can bridge this gap. Marine mammals in particular are extremely sensitive to human influence and habitat degradation. Currently 21 marine

mammals are listed as 'endangered' while only one (the gray whale) has ever been delisted. In order to improve the Endangered Species act regarding marine mammals one must understand the varying components that affect global marine environments.

Killer whales (*Orcinus orca*) are the most widely distributed cetacean species in the world (Reeves et al, 2002), yet few populations are considered endangered. The northeast pacific population of killer whales, which is comprised of three distinct pods (J, K, and L), has been designated as resident killer whales (Bigg et al 1990). This designation is based off long-term investigations of distinct acoustic dialects (Ford, 1989), foraging (Bigg et al. 1990), and social structure (Bigg et al., 1990). Returning every summer to the inland waters of Washington State to forage on migrating salmon (Williams et al., 2009), Southern Resident killer whales (SRKW) have become an indisputable icon of the region (SRKW Recovery Plan 2008.)

Due to distinct markings on the animals, a yearly census has been carried out since 1974 (Center for Whale Research, Friday Harbor, WA). This census allows scientists to analyze population dynamics and to monitor abundance. After a 20% decline between 1996 and 2001 (SRKW Recovery Plan 2008), the population was listed as "endangered" under the Endangered Species Act (ESA) and "depleted" under the Marine Mammal Protection Act (MMPA) (SRKW Recovery Plan 2008). Currently the population of Southern Resident killer whales is estimated at eighty-seven (Center for Whale Research Friday Harbor, WA).

Under the ESA, once a species is listed, there is a federal requirement to "develop and implement recovery plans for the conservation and survival of endangered and threatened species" (SRKW Recovery plan, 2008). While the exact causes of decline are undetermined, the final recovery plan for Southern Residents was released in 2008. Primary concerns that were

attributed to the depletion of the species include (1) reductions in quantity or quality of prey, (2) high levels of pollutants (PCBs), and (3) sound and disturbance from vessel traffic (SRKW Recovery Plan 2008)

Marine mammals, and killer whales in particular, are extremely vocal. They depend on their sonar capabilities for detecting food, communicating, reproducing, and detecting predators and navigation (Weilgart, 2007). It is likely that increases in shipping, oil exploration, military activity, and recreational boating disturb these key aspects of behavior. (Wright et al., 2007). Tourism around the Southern Resident population has increased dramatically in recent years (Williams et al. 2009). On a typical summer day, fourteen to twenty-eight vessels follow a group of killer whales (Erbe, 2002), and it has been observed that as many as 126 vessels follow this particular population (Koski 2006). Responses to vessel traffic include changes in respiration patterns, surface active behaviors, swimming velocity, vocal behavior, activity state, and displacement from habitat (Williams, 2009, Ashe et al. 2010) In order to reduce the sound and disturbance vessels can cause, NOAA released vessel guidelines for public comment while continuing to address other recovery plan concerns.

The three components of the vessel regulations consisted of: 200-yard vessel approach restriction, no parking in the path of traveling whales, and the west side of San Juan Island would be closed to recreational boaters. These potential restrictions were met with heavy resentment, most notably from the whale watching and commercial kayak industry (NOAA-Vessel Regulations Public Comments) After three vocal, public meetings, the final vessel regulations were released in April 2011. The final proposal mandated that no vessel can park in the path of whales and placed a 200-yard buffer between vessels and whales (NOAA Federal

Vessel Guidelines 2011) Due to the contentious nature of closing the west side of San Juan Island, a known foraging ground (Williams 2009), this recommendation was left out of the final ruling. The new federal went into affect in May of 2011. This was the first time a measureable law is in place protecting this population.

Methods

In order to understand the effects vessels have on killer whales it is critical to understand the density of vessels surrounding the whales in critical summer months. By collaborating with Soundwatch, an organization that has been on the water for over 18 years, I was able to partially collect, scrub, and analyze vessel density and violations of federal law and guidelines. I began by analyzing the density and type of boats that surround this population. Soundwatch collects information pertaining to the types of commercial boats that are on the water (US or Canadian), private vessels (kayak, boat, sailboat), as well as a variety of other vessels (fishing, freighter, research). I calculated the average, max, min, standard error, and counts for a variety of fields. The field that became the most important to my research were private vessel, and commercial operations. This was due to both of these categories being the most prevalent on the water.

I then began analyzing vessel incidents for summer 2011. A vessel incident is specifically defined as a driver of a commercial whale watch vessel, private boat operator, kayaker or other vessel operating contrary to current voluntary Be Whale Wise Guidelines, Kayakers Code of Conduct, and federal and state vessel law. Upon understand the primary violations we saw, I

began to break it down to who was committing these violations (private, commercial, kayak). By understand on a broad scale what boats are on the water and who is committing infractions we can begin to revise and hopefully improve federal protections surrounding this population.

Results

Understanding the general location vessel counts occur can be a useful tool to understand core summer habitat use by southern residents. Soundwatch, targets known locations of whale and boater activity and therefore can conduct education and monitor vessels. A more complete depiction of SRKW habitat use can be found though The Whale Museum's annual and long-term Orca Master data sets. There are key areas where boats and whales overlap due to fishing, transiting, as well as vessel activity specifically focused on killer whales. Large marine freighters also frequent southern resident critical habitat, and can have acoustic influences from farther than 200 yards away.

Southern Resident Killer Whales are the primary target for eco-tourism within the Salish Sea. There has been an average of 18 vessels surrounding this population from 1998-2011, May through September and the hours of 9 a.m. and 6 p.m. as observed by Soundwatch. (Figure 1). The average number of vessels accompanying this population for 2011 was 12 vessels (Figure 3). This is a decrease from the 2010 average of 13 vessels. This decreasing trend however is not consistent with local marine vessel use data which report a steady increase to full capacity of dock usage. This indicates that the lower boat density surrounding killer whales is not due to a decrease of boating activity within their critical habitat. The lower trend most likely reflects an active effort of the whale watching

industry to mitigate large clustering around whales and to spend increased time of their trip on viewing other marine wildlife.

This would essentially spread out the fleet and result in decreased density of the boats around the whales where Soundwatch is recording data. In addition to the commercial whale watching fleet being farther spread out, recent data suggests that the whales themselves are also becoming more spread out. As salmon runs continue to decline the whales have become more spread out in an attempt to increase foraging success. When analyzing historic Soundwatch data we see that pods are generally cataloged as being 'tight' and this resulted in a higher density of boats surrounding these close groups. This year the majority of orcas were recorded as being 'loose or 'spread in groups.' This behavior would cause the boats, both commercial and private, to be spread out as well.

The 2011 annual maximum number of vessels observed with whales was 62 boats, which is an increase from 2010 which has a maximum of 54. This maximum was recorded in September during a large fishing derby. A maximum of 25 commercial whale watching boats were recorded in August. While the maximum of 60 private boats was recorded in September, coinciding with a large fishing event. The maximum number of kayakers that were recorded was 23 and this occurred in August. Annual and monthly maximum vessel totals are often more than double the annual average vessel total, thus neither the average nor maximum number best describes the actual vessel conditions the whales regularly experience. The 2011 monthly average of commercial whale watch, private vessels, kayakers as well as commercial fishing vessels remained mostly constant through the season, with a spike in August and September. There is an average spike in vessel activity between 11 a.m. and 3 p.m. with a dip from 12 a.m. to 1 p.m. due to commercial vessels

returning to port to exchange passengers. In 2011 this pattern stayed consistent with previous years. September is generally categorized as having lower vessel activity as the whales are beginning to become more unpredictable. However, the long Labor Day weekend and a 4-day fishing derby in San Juan County can increase vessel activity and can produce a larger average. In 2011 Pink Salmon runs were particularly high which resulted in an increasing in fishing activity in September. Yet as the whales become more spread and unpredictable the commercial season generally tapers off in October. Soundwatch did not collect any data in October 2011.

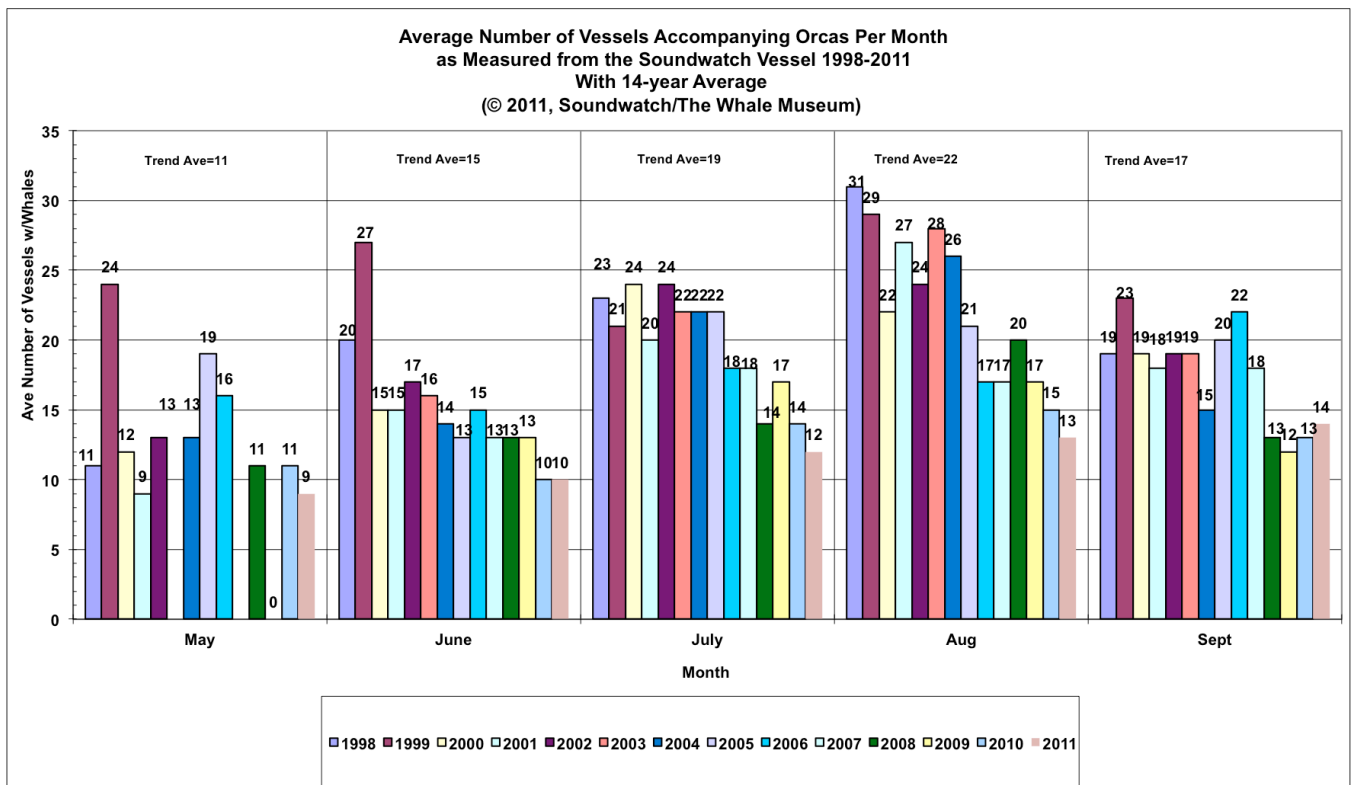


Figure 1- Average Number of Vessels Accompanying Orcas by Month, 1998-2011

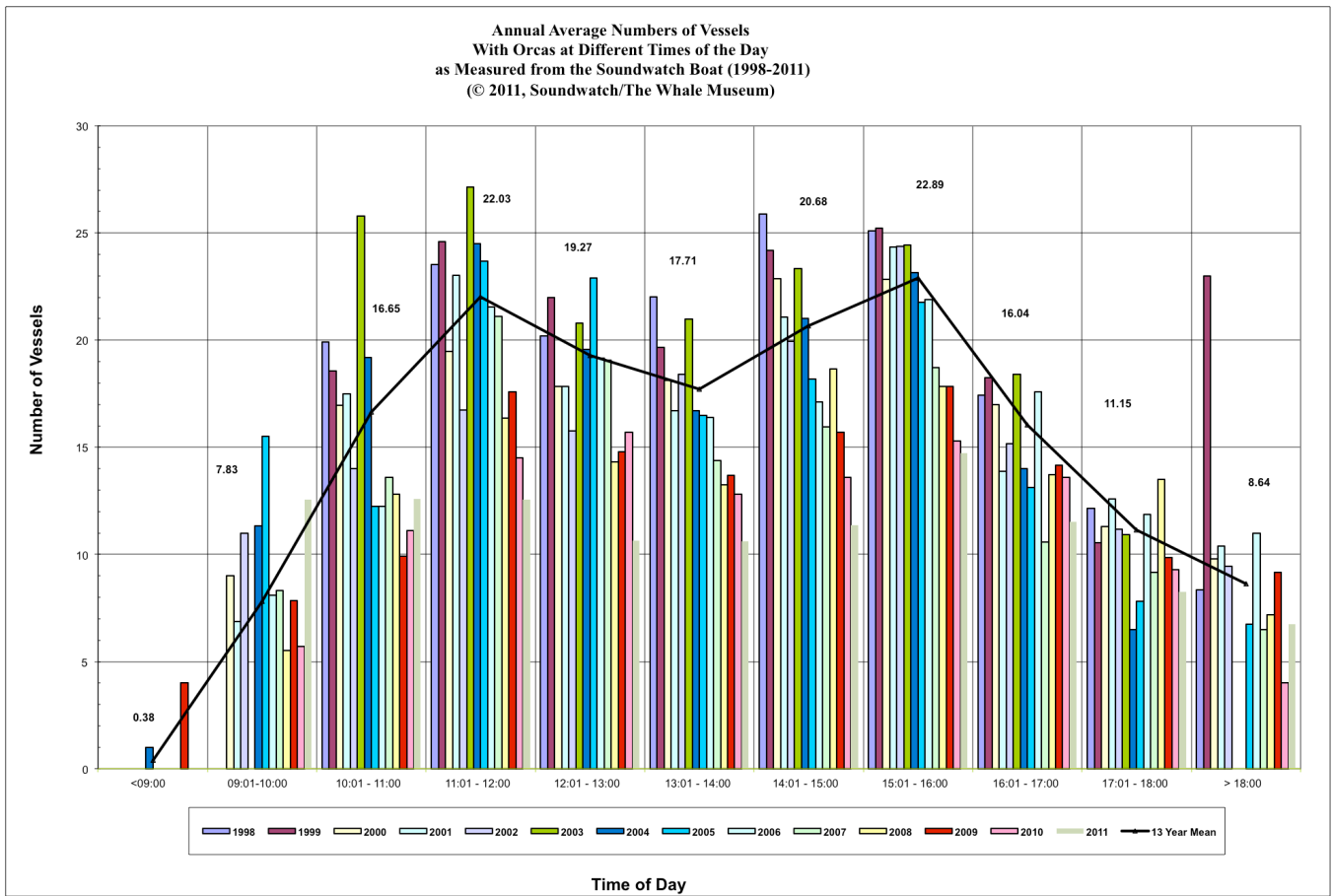


Figure 2- Annual Average Numbers of Vessels with Orcas by Time of Day, 1998-2011

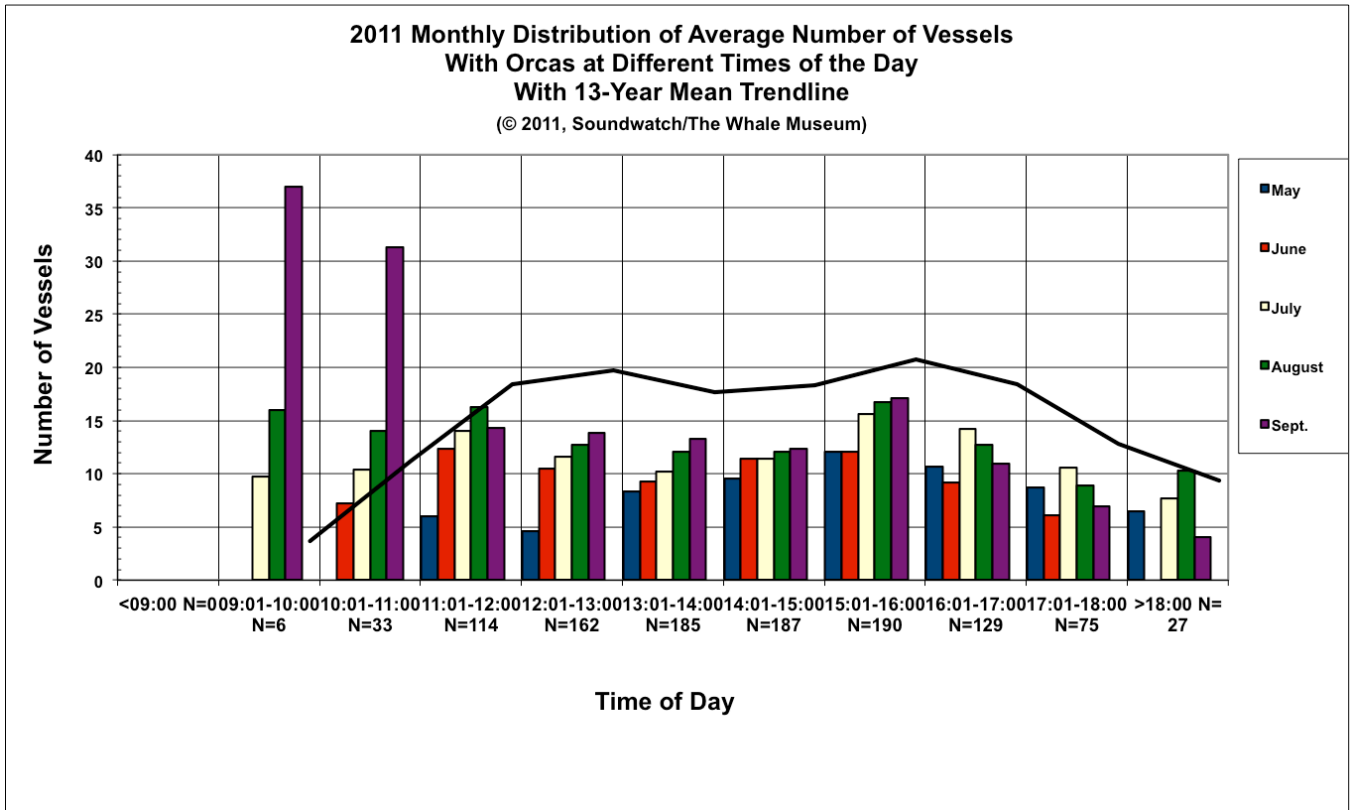


Figure 3- Monthly Number of Vessels with Whales by Time of Day, June-September 2011

*Annual Average Number of Vessels with Whales 2011= 12
 (© 2011, Soundwatch/The Whale Museum)

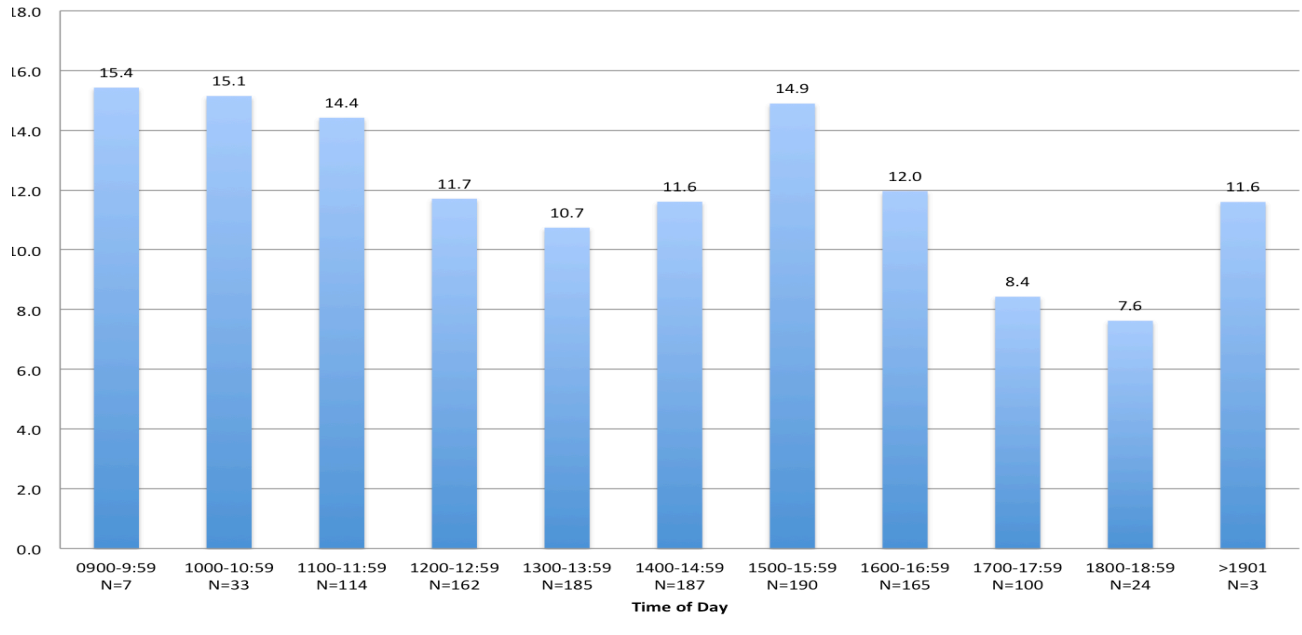


Figure 5- Average Number of Vessels with Whales by Time of Day, May-September 2011

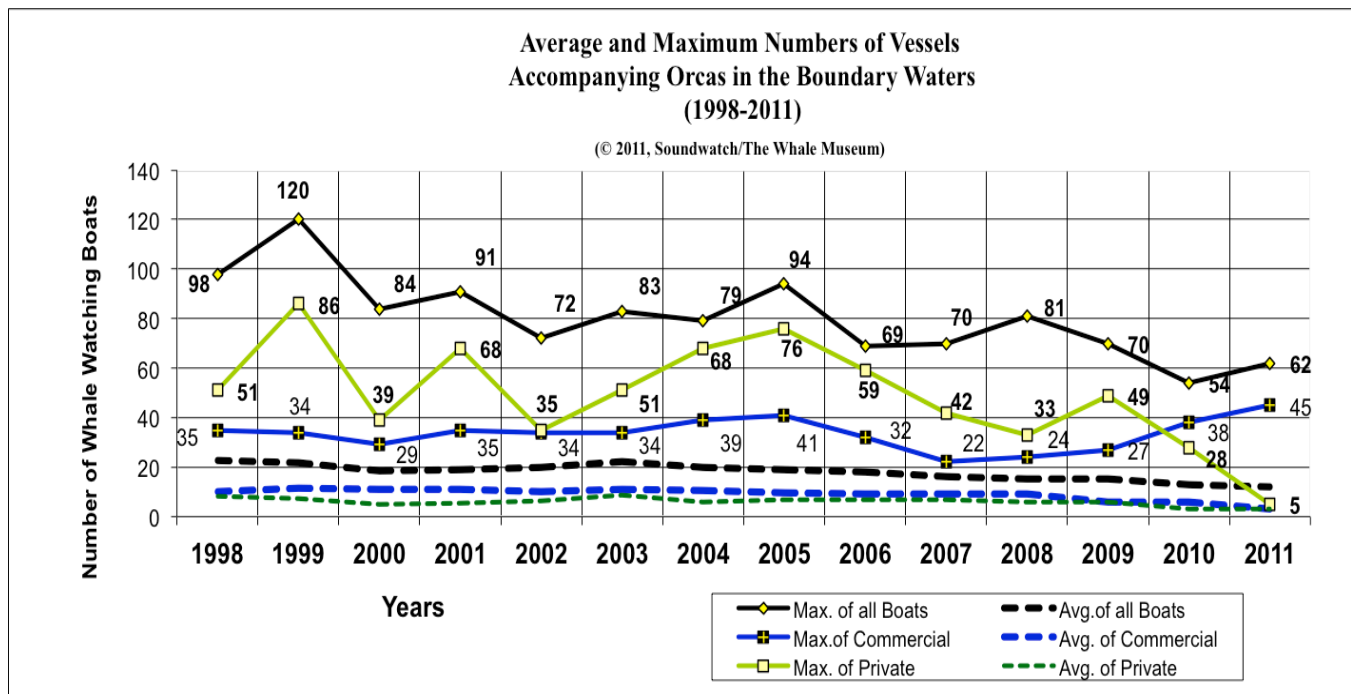


Figure 6- Annual Vessel Type Averages and Maximums Accompanying Orcas, May-September 1998-2011

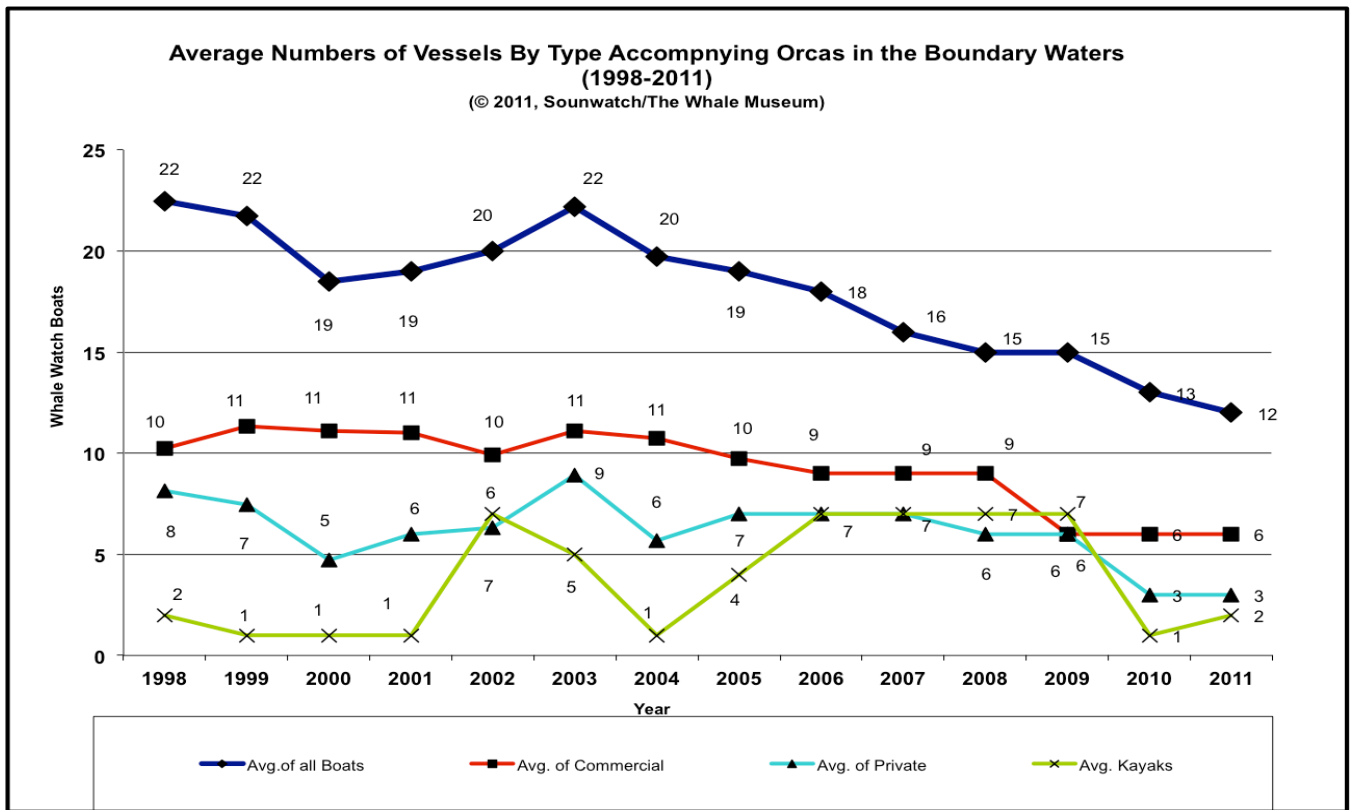


Figure 6- Annual Averages of Vessel Types Accompanying Orcas , May-September 1998-2011

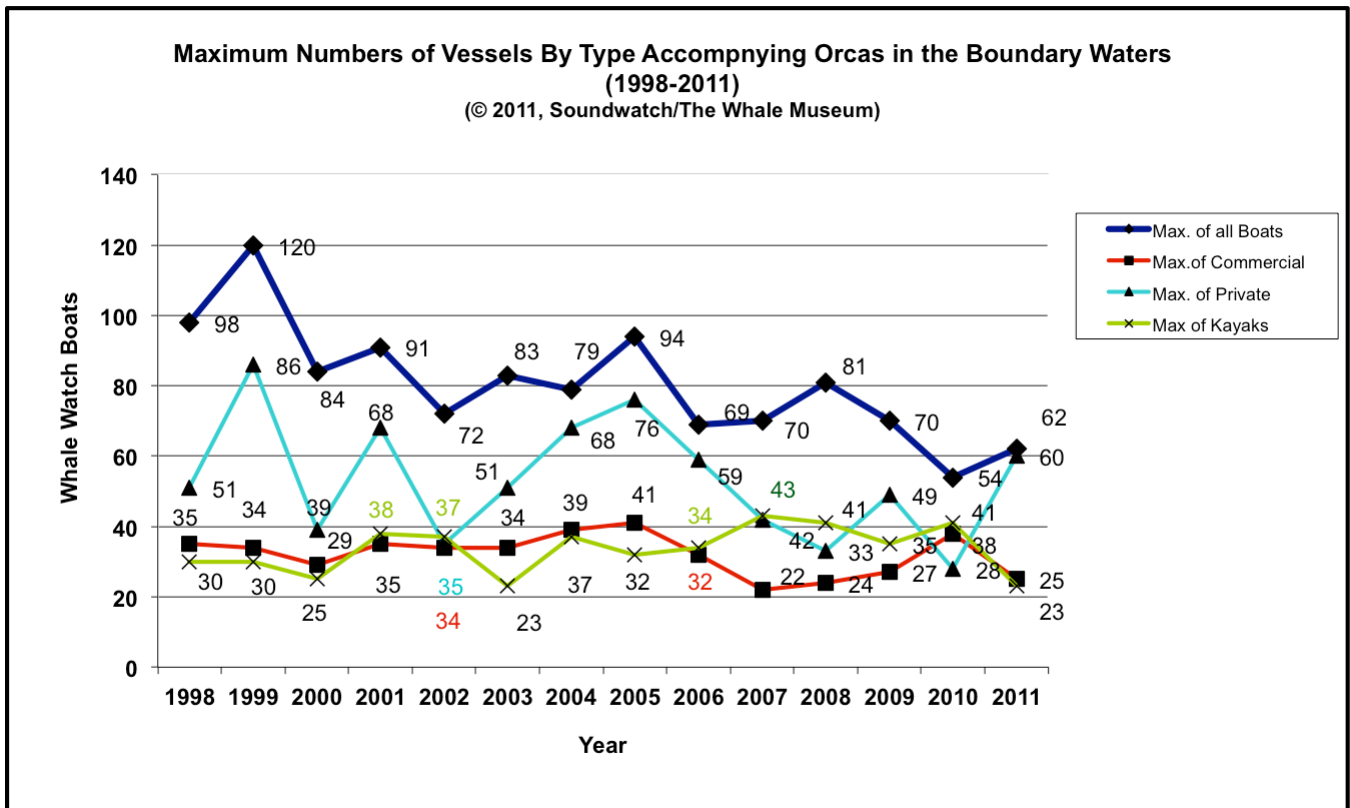


Figure 7- Annual Maximums of Vessel Types Accompanying Orcas, May-September, 1998-2011

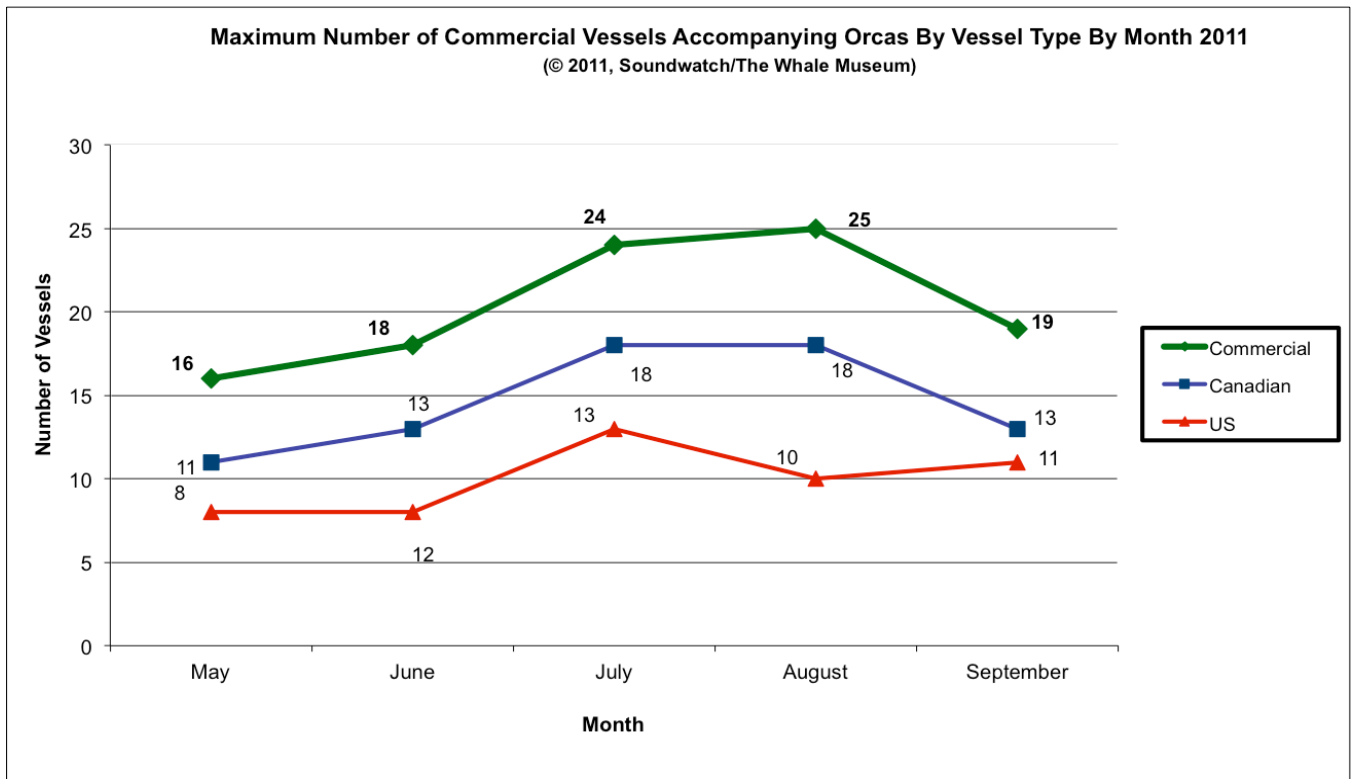


Figure 8- Average Number of Commercial Vessels with Whales by Commercial Vessel Type by Month 2011

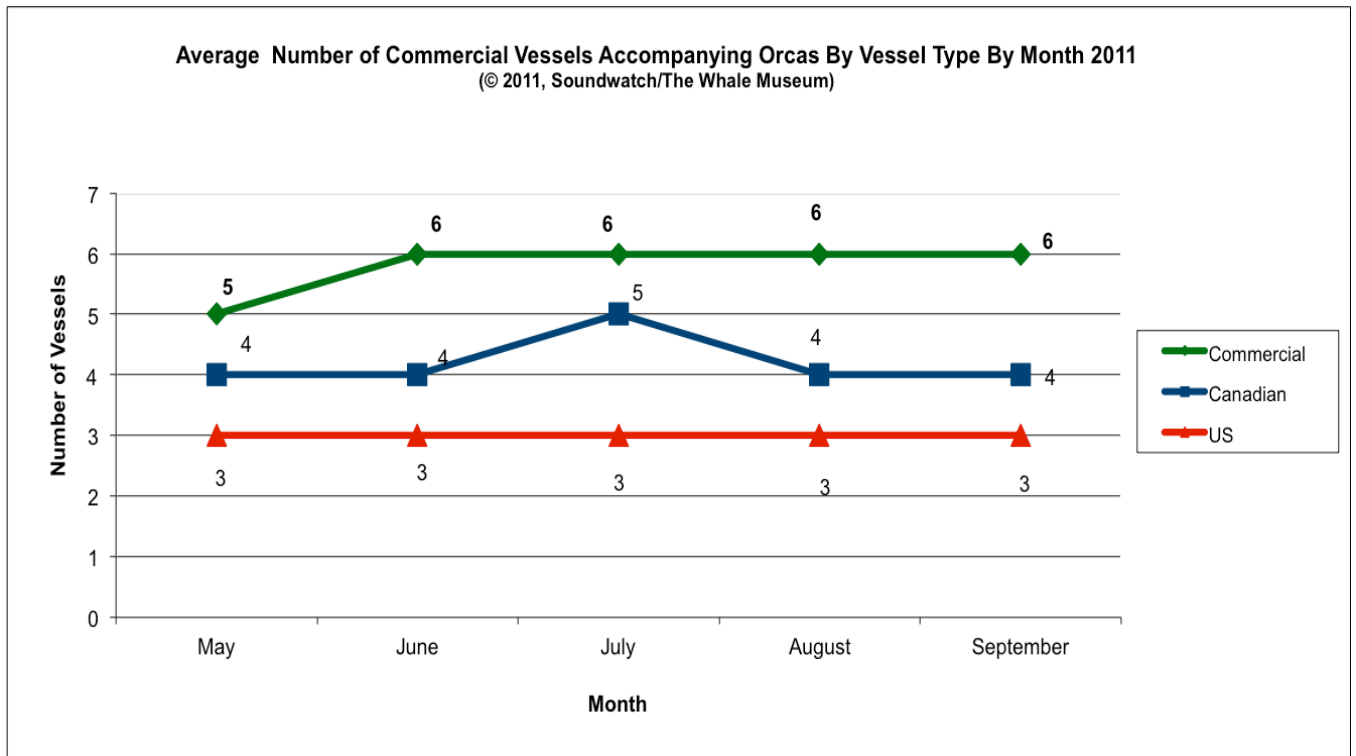


Figure 9- Maximum Number of Commercial Vessels with Whales by Commercial Vessel Type by Month 2011

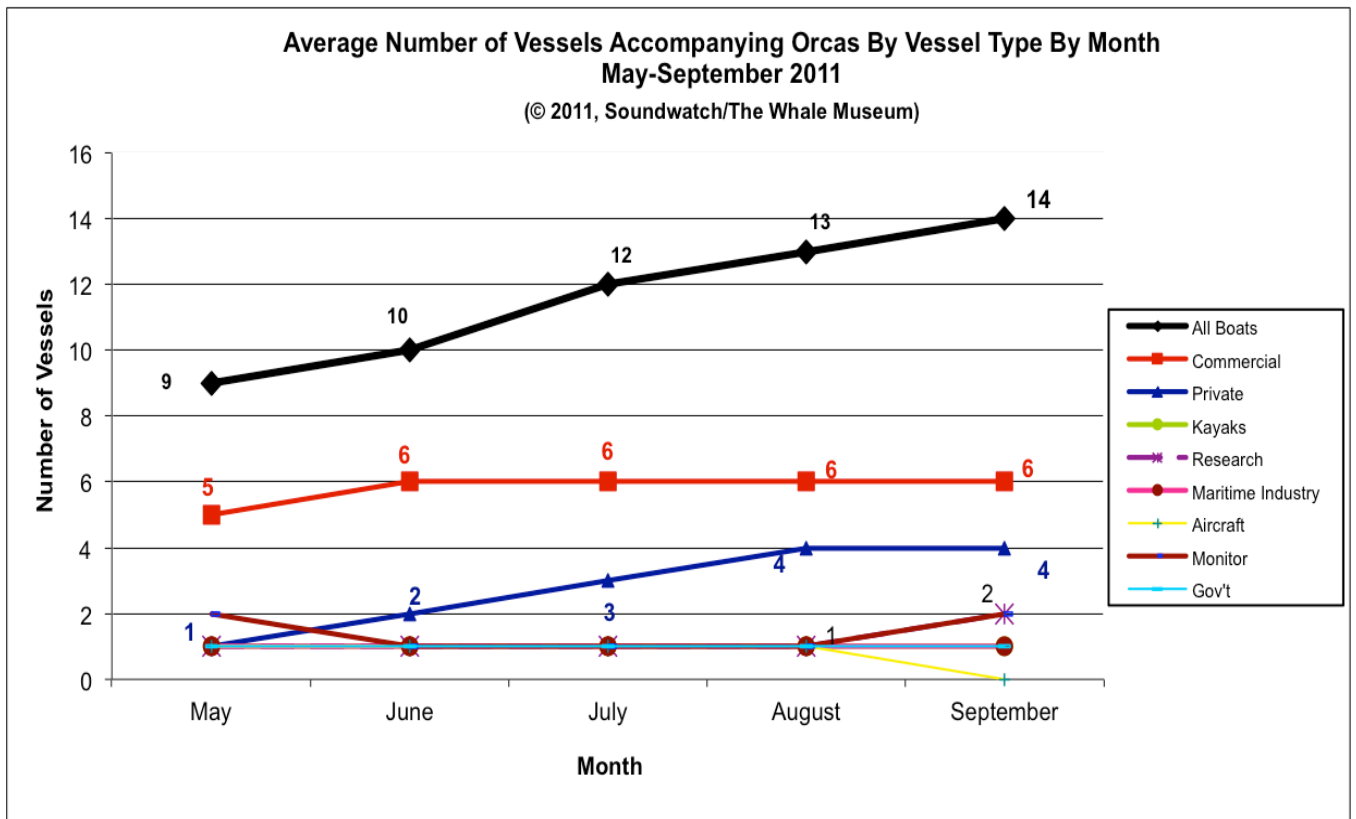


Figure 8- Monthly Average by Type of Vessels with Orcas, May-September, 2011

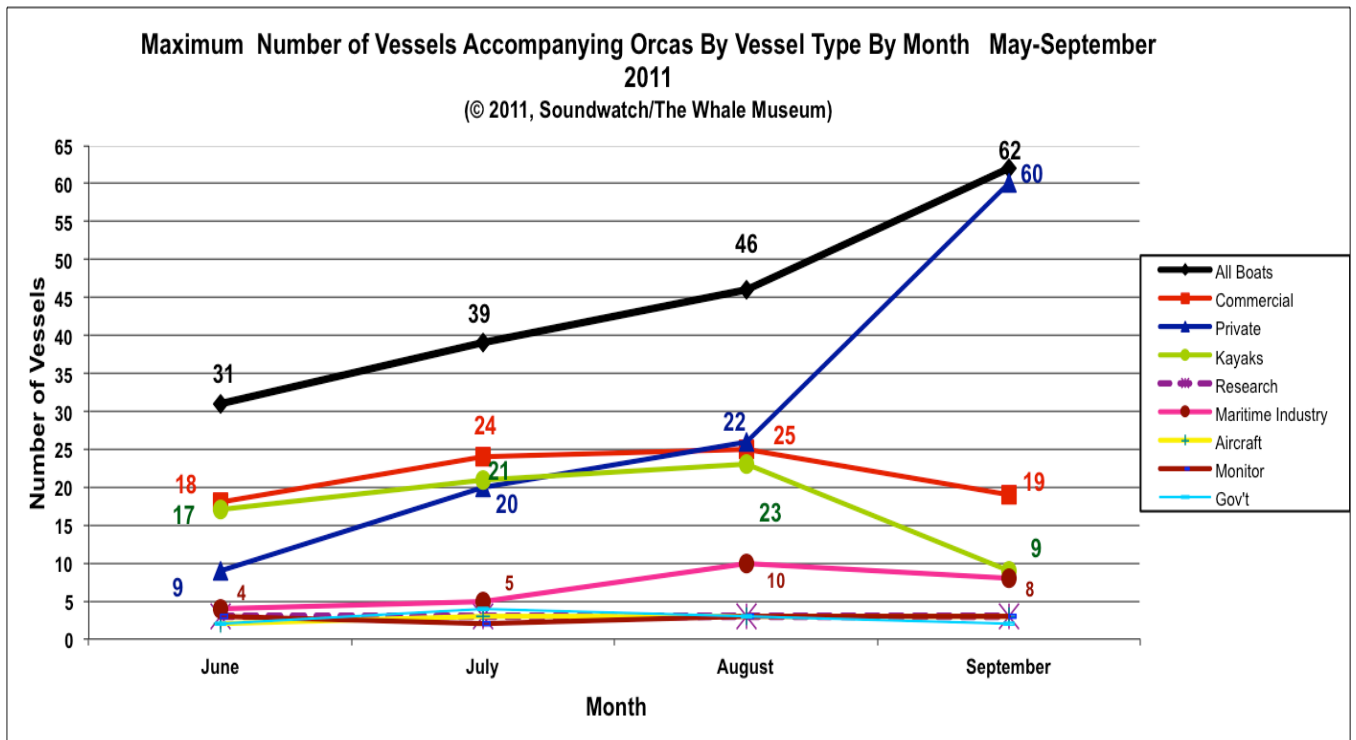


Figure 9- Monthly Maximum by Type of Vessels with Orcas, May-September, 2011

Although there is a great variety of vessels surrounding this population, it is important to remember that this population resides in a dynamic environment that plays host to multiple maritime activities. Vessels that are engaged in fishing often overlap with whales, while private kayakers can often find themselves in the midst of a whale. In 2011 on average one was likely to see 6 commercial boats following a group of whales, while there would be only 3 private. Due to unexpected high returns of sockeye salmon in the region, commercial and recreational fishing levels have affected the average of private boaters in the region. Throughout the 2011 season we saw commercial vessels being consistently around the whales from May-September. Within these months there were key times of day that one could expect to see a high concentration of vessels surrounding the whales. These monthly and daily trends are important information for enforcement agents as they seek to target specific times and dates when vessel traffic is known to be high. As NOAA seeks to revise and enhance the federal law it is important to gain a broad understanding of boater activity surrounding this endangered population.

Soundwatch Vessel Incident Trends

In addition to monitoring vessel activity Soundwatch catalogs violations of federal law and voluntary guidelines. Incidents are recorded using a premade set of codes. The type of vessel, location, date, and time of day are recorded in order to analyze trends and primary areas of concern. Utilizing this data is useful for future studies focusing on high-density boating areas as well as targeting outreach efforts and vessel management. Soundwatch monitors a variety of vessels including Canadian commercial operations, US commercial operations, recreational boats, kayaks, and sail boats, as well as acoustic vessels such as freighters. A vessel incident is specifically defined as a driver of a

commercial whale watch vessel, private boat operator, kayaker or other vessel operating contrary to current voluntary Be Whale Wise Guidelines, Kayakers Code of Conduct, and federal and state vessel regulations.

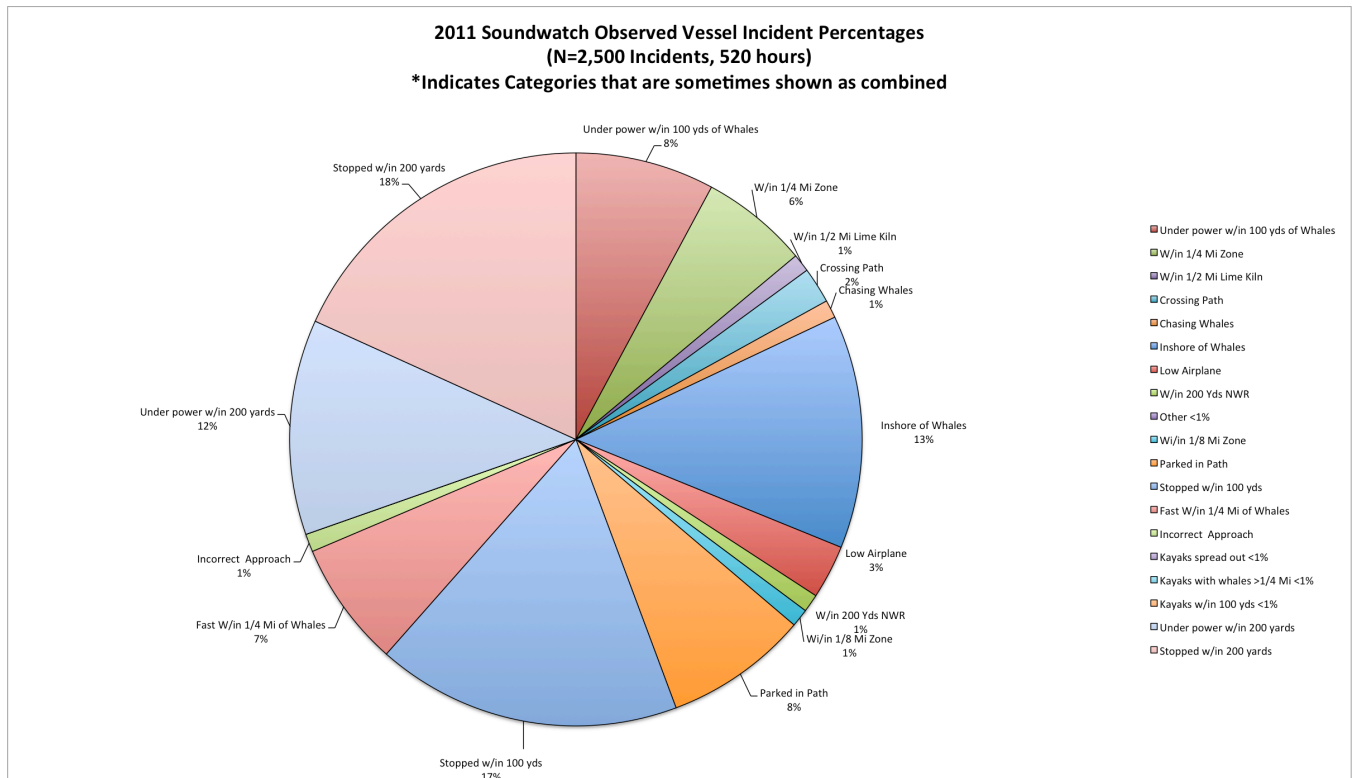


Figure 10- Observed Vessel Incident Percentages May – September 2011

For the 2011 boating season the top violations Soundwatch observed that vessels being stopped within 200 yards (18%) and within 100 yards (17%) (Figure 10). This was followed by being inshore of whales (13%), under power within 200 yards of whales (12%), being under power within 100 yards of whales (8%) and parked in whales path (8%). It was anticipated that there would a high number of 200 yard incidents as when one is within 100 yards one is also violating the 200 yard federal law. Of the top four incidents three of them are violations of federal law. The other incidents that are recorded are violations of guidelines and have been in place since 1993, but revised again in 2002 with the creation of Be Whale Wise.

Soundwatch Observed Vessel Types for Total Annual Incidents by Percentage 2011(N=2,500).
 (© 2011, Soundwatch/The Whale Museum)

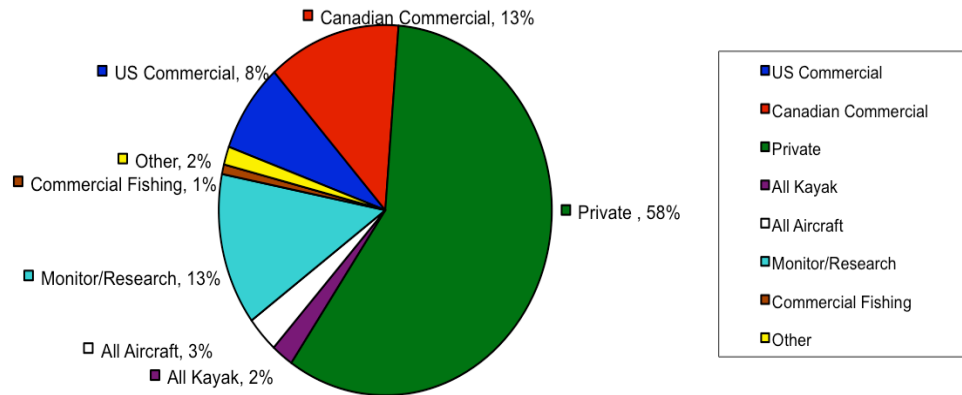


Figure 11- Observed Vessel Types for Total Annual Incidents by percentage 2011

Of the observed incidents for 2011 58% of them were committed by private vessels. (Figure 11) This was followed by 21% from the commercial whale watch industry (8% US and 13% Canadian). Marine monitoring accounted for 13% of the recorded incidents and this is due to Soundwatch being accountable to incidents and violating federal law as well as the public. Also Soundwatch is generally attempting to reach the private boaters to give them information about the guidelines before an incident occurs. This places Soundwatch generally in the middle of the whales and vessels and then ultimately violating a guideline. The other incidents that were observed were from aircrafts (3%) generally flying to low, and commercial fishing (1%). Also kayakers accounted for 2% of the incidents in 2011. Breaking down the violations into top violations and who committed them shows us that private boats being inshore of whales was a large component of the incidents, but there was a small count for these incidents giving an arbitrary percentage. (Figure 12). The top violations were generally being within close proximity to the whales and these were on average much higher for private vessels than any other boat type.

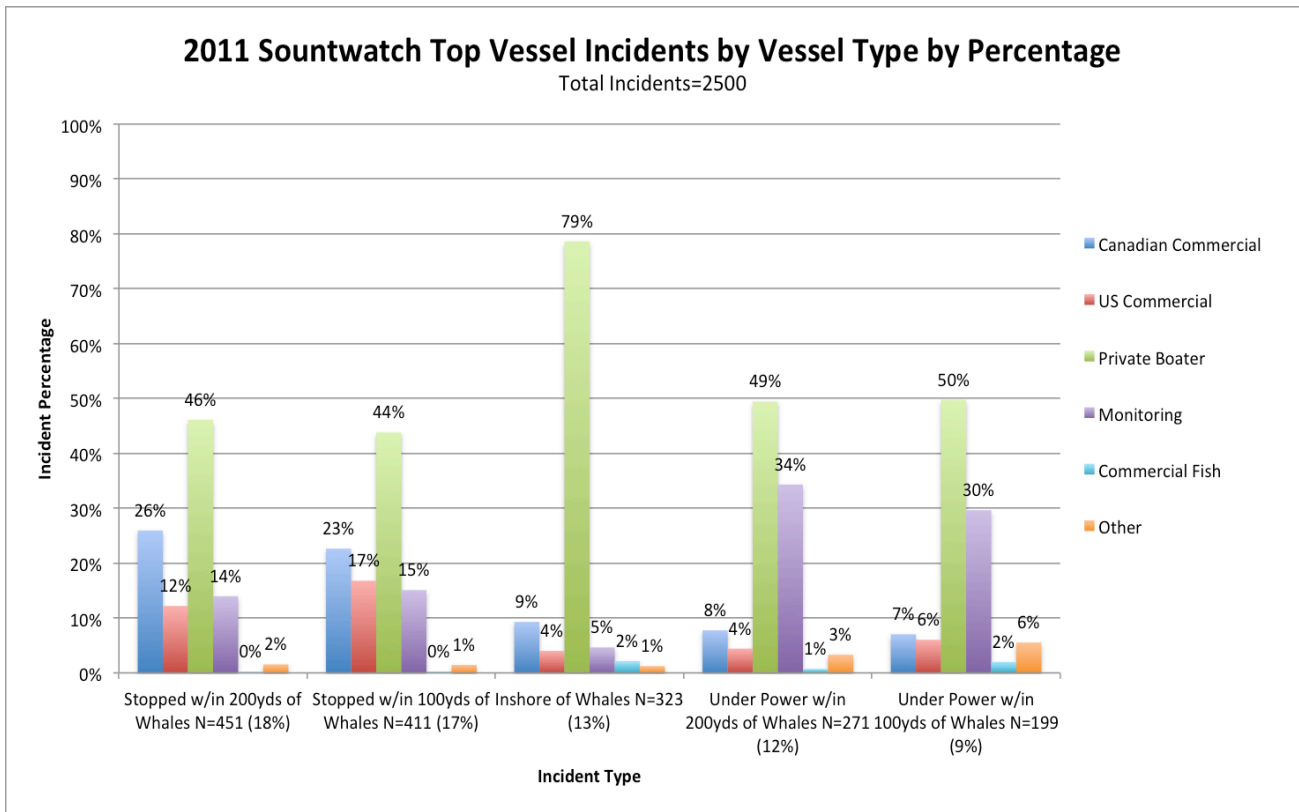


Figure 12- Top Vessel Incidents by Vessel Type by Percentage 2011

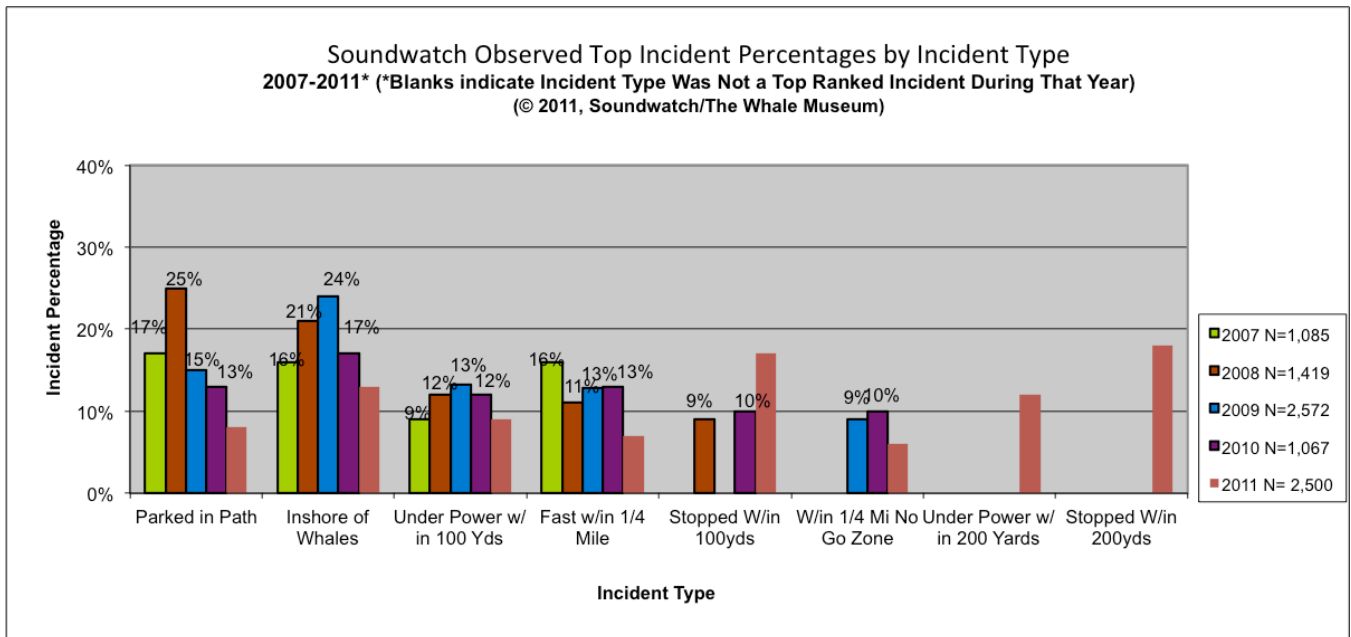


Figure 12- Observed Incident Percentages by Incident Type 2001-2011

2011 Soundwatch Monitoring Incidents by Percentage 13% (N=329) of Total Incidents (N=2,500)

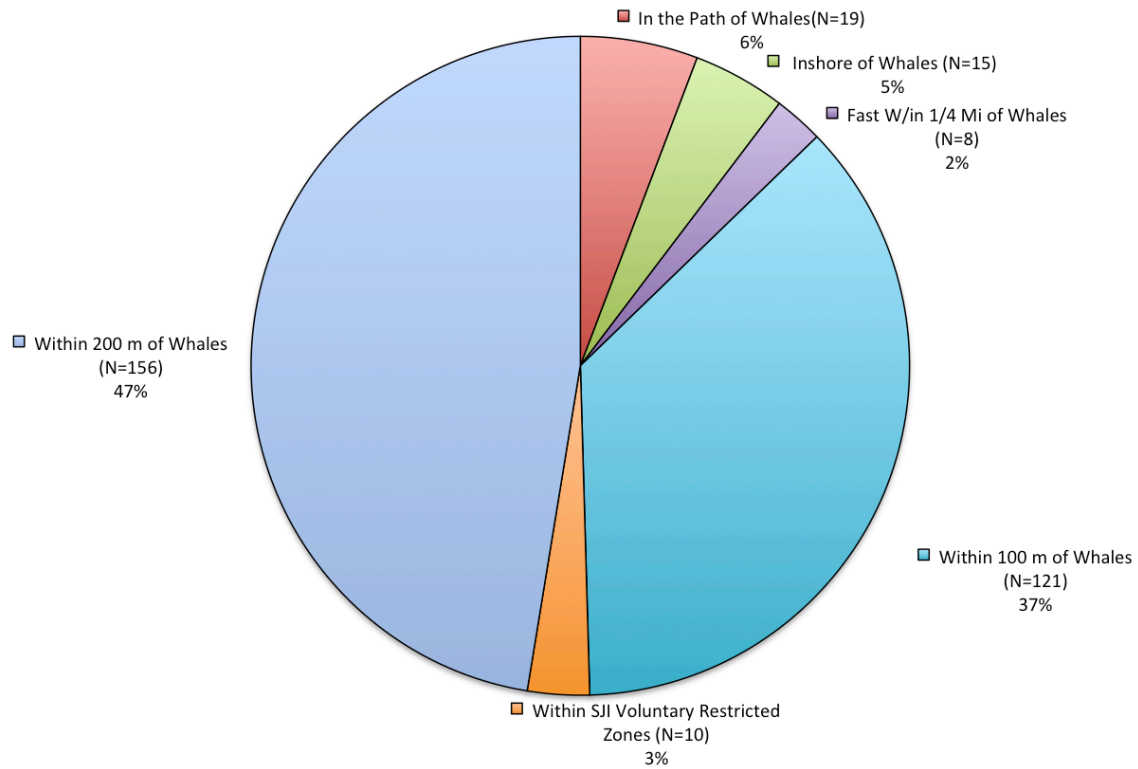


Figure 14- Soundwatch Monitoring Incidents by Percentage

One component of the Soundwatch boater education program is to be transparent to the public in terms of their own incidents. The top incidents that were recorded were being within 200 m of whales (47%) and being within 100m of whales (37%). This once again is due to Soundawatch’s mission to intercept private boaters to educate them before an incident occurs. This generally places them in close proximity to the whales.

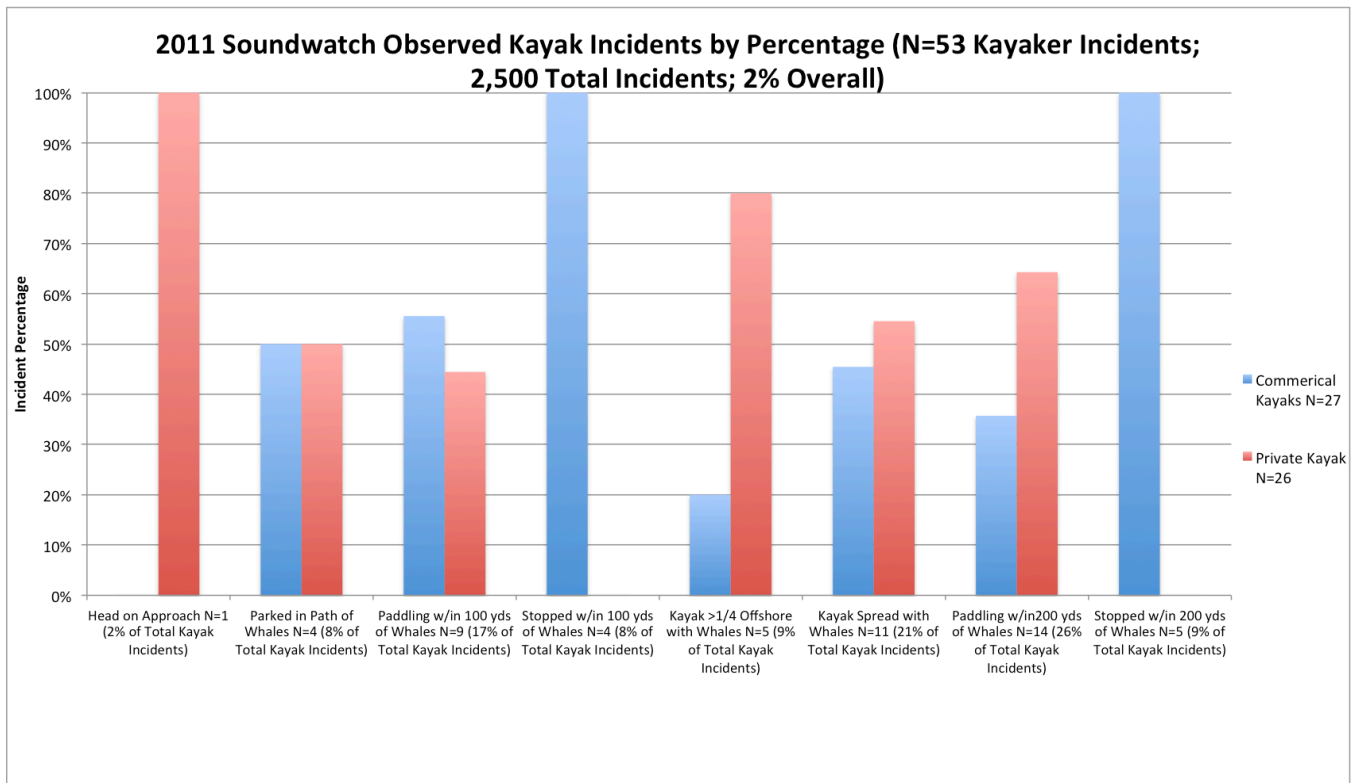


Figure 15- Observed Kayak Incidents by Percentage

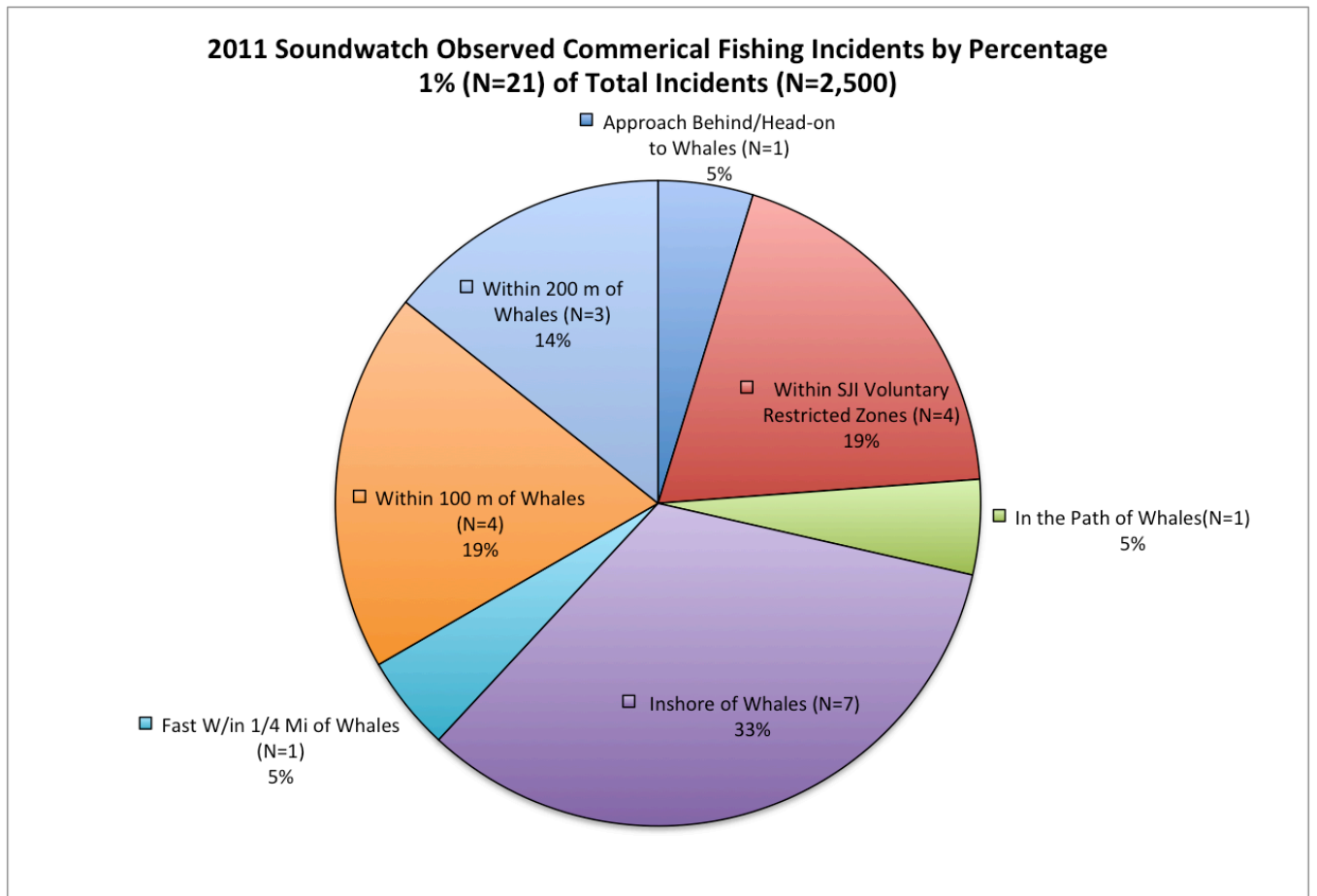


Figure 16- Observed Commercial Fishing Incidents by Percentage

Conclusion

Although there are a variety of guidelines, federal law, and monitoring agents on the water vessels are still a large component of these whales every day life. While the effects a specific number of vessels can have on a whale is still largely unknown we can begin to understand the long term and cumulative effects associated with vessel activity. Also although the average number of boats surrounding this population is 12 this is not an accurate representation of on the water activity. The whales often have less then or way more than 12 boats and it is more often than not a large number of vessels surrounding this endangered population.

Also the violations we are seeing are primarily being committed by private boaters, indicating that there is a large need for education and outreach. Soundwatch is only one organization on the water and while have contacted 4,460 people this boating season in the field there is still a large amount that needs to be done. One of the primary components of NOAA's recovery plan was educating the public. One of the primary ways NOAA can hope to reduce violations of federal law but also incidents is to reach out to the public and teach them about the current guidelines. This will automatically reduce incidents and lower the overall impact on this population. NOAA also funds programs like Soundwatch that not only monitor boating activity but actively intercept and educate the public in the field. Programs like this can help reduce impacts on killer whales by stopping incidents before they happen.

Another component of this season that is worth noting is the decline of boats surrounding the whales presented in Figure 6. As noted early salmon runs have been declining drastically in this region. Chinook salmon, the orcas preferred food, is currently

listed as endangered and facing it's own set of difficulty being recovered. In order to increase the whales foraging success they are spreading out further to find the reduced food. This activity state (spread in loose groups) results in the boats being spread as well. A group of whales could be at the north and south point of the island, and Soudnwatch can only be at one place monitoring activity. This decline is in essence arbitrary. Although for future study it would be interesting to get a stronger monitoring force on the water and gain a better picture of activity on the water. These future studies would emphasize the point that reduced salmon results in loosely spread whales which results in boats being more spread out.

Moving forward into future seasons this first summer provides us with a baseline to measure the effectiveness of federal law surrounding these killer whales. Currently we have no basis to judge the law on. This study attempts to take a snapshot of the first summer federal law is in place surrounding these whales. It will be sued as a comparison for future boating seasons. Understanding boater activity around the whales will provide NOAA an opportunity to increase enforcement or revise the law.

Acknowledgements

A huge thank you to Kari Koski and everyone at the Whale Museum. The resources and guidance provided by Friday Harbor laboratories and Susan Thisstle. Also, the generous support from Henry and Holly Wendt for the FHL research apprenticeship program, and the Mary Gates Endowment.