

Where are the Greatest Great Whale Gatherings?

Gehan de Silva Wijeyeratne



Clockwise from top left: Blue Whale (c) Gehan de Silva Wijeyeratne, Grey Whale (c) Chris Breen, Wildlife Worldwide, Humpback Whale (c) Joshua Barton and Dwarf Minke Whale (c) Matt Curnock.

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Where are the Greatest Great Whale Gatherings?

If you were a documentary filmmaker wanting to film the greatest gatherings of great whales, where would you go? The same question might cross the mind of a scientist, a whale enthusiast planning a whale watching tour or a commercial wildlife tour operator planning a product expansion. In this article, I hope to provide some answers. What surprised me is that although much has been written about whales, very little has been written to pinpoint which species and where the greatest great whale gatherings take place. What is the equivalent in the oceans, of the annually recurring Elephant Gathering in Minneriya in Sri Lanka?

To share my conclusions up-front, it seems that of any great whale, the greatest recurring gathering is that of the Grey Whales nursing young in Laguna Ojo de Liebre in Mexico. Other whales which gather in large numbers, albeit unpredictably and often with little or no public access to ordinary tourists, include Antarctic Minke Whales in Eastern Antarctica. These aggregations are often driven by unpredictable super-blooms of krill. Only one toothed whale, the Sperm Whale makes it into the list of great whales. For the Sperm Whale, the greatest gatherings take place off Sri Lanka, but they are highly unpredictable unlike the gatherings of the Grey Whales. However, when the Sperm Whale super-pods are seen, they may make a stronger visual impression as large numbers move together. With the Grey Whales, they are spread out in a large lagoon and only a few at a time may be in the field of view.

Great whales for which there have been records of large gatherings include the Sperm Whale, Antarctic Minke Whale, Grey Whale, Humpback Whale and the Bowhead Whale. Although Blue Whales are not known in the literature for large aggregations, I mention the Blue Whales off Sri Lanka. Sperm Whales are the most social of the great whales. It seems that the famous Elephant Gathering in Sri Lanka is mirrored in the sea by a Sperm Whale Gathering where in a relatively concentrated area over 250 Sperm Whales may be seen. (More details on the Elephant Gathering are in the article 'Branding Wildlife Brands: The Elephant Gathering' published in the Daily FT (Sri Lanka) on 27th September 2012). However, the Sperm Whale Gathering lacks the same predictability of time and location as the Elephant Gathering and I would caution people against travelling to Sri Lanka in the expectation that their visits will coincide with one of these great gatherings. But Sri Lanka seems to offer one of the best chances to view or film a visually spectacular great gathering of

great whales and it is special that a great whale gathering is within reach of the public, albeit subject to chance.

I focus on the 'great whales' as large gatherings by them attract public interest although large gatherings by the smaller species of dolphins are no less spectacular. The great whales were subject to ferocious hunting in the 19th and 20th centuries. We very nearly drove these sentient beings to extinction. The term 'great whale' encompasses the world's 13 largest whales (or more, depending on taxonomic splits) including the Blue, Fin, Sei, Common and Antarctic Minke, Humpback, Grey, Bryde's, and the 3 species of Right Whales (the North Atlantic, North Pacific and Southern), Bowhead and the Sperm Whale. The whales in scientific taxonomy belong to two groups, the baleen whales and the toothed whales. The former have sheets of baleen or whalebone suspended from the upper jaw, which they use to filter feed. Of the great whales, all but the Sperm Whale are baleen whales. In this article published in four parts, I will discuss some of the papers and observations, which relate to large aggregations of great whales.

My discussion on the baleen whales is relatively brief, as it seems that the Grey Whale is a clear winner and the other large aggregations of the other baleen whales have limitations with access, unpredictability or being too spread out to offer a visual spectacle of a mass of animals. I dwell at length on the Sperm Whale, long famed for large aggregations, but it seems not as much as the popular literature would have us believe. For ease of reference, I have broken this multi-part article into a section on baleen whales where I discuss a few species and a second section on toothed whales where I discuss just one species, the Sperm Whale.

Baleen Whales of the Northern Hemisphere

Grey Whales

The largest great whale gathering I know of based on published data, since W.D. Boyer's observation (more on this later in the second section on Sperm Whales) is from a paper by Steven Swart and others which refers to counts in the Laguna San Ignacio and in the Ojo de Liebre. In the Laguna San Ignacio they used a standard line transect method by travelling in a 7m outboard powered boat at a speed of 11km/hr. This is faster than the typical speed of the whales, which reduces the likelihood of the same whale being counted twice. The transect takes approximately three hours. In their paper titled 'Numbers of Gray Whale (*Estrichtus robustus*) utilizing Laguna San Ignacio and Laguna Ojo de Liebre, Baja California Sur, Mexico during the winter breeding seasons:2007-2003' they provide counts of adults and female-calf pairs combined, from 107 boat surveys between 2007 and 2013. The highest count was 320 on 26th February 2011, which comprised of 261 single adults and 59 mother-calf pairs. Thus if the calves were added as well the total count would have been 379. The lagoon is over 8km wide in places with the boat having visibility to 2.5km on either side and therefore these boat-based surveys are able to count the total number of whales in the lagoon with a reasonable chance of success.

But very importantly in the context of my article, their paper also includes the results of 12 surveys between January and April 2013 in the Laguna Ojo de Liebre, two of the three primary Grey Whale calving and breeding lagoons for the Grey Whales in the Eastern Pacific. The lagoon is 48km long and 9km wide. On 25th February 2013, they counted 137 single adults and 592 mother-calf pairs giving a count of 720. This would be 1,321 whales if calves were counted as an individual whale. They also include a table of data (provided by the Subsecretaria de Gestion Para La Proteccion Ambiental, Direccion General de Vida Silvestre, of Mexico) which summarises the highest counts between 2007 and 2013. In all of these years, the highest count of single adults and mother-calf pairs (treated as a single unit) were in excess of 500. The highest was on 5th March 2012 and comprised of 1,523 single adults and 1,198 mother- calf-pairs to give a count of 2,721. If the calves are added, this would be 4,919 individual Grey Whales. Such recurrent, large numbers of whales gathering seasonally is probably be the greatest recurring gathering of great whales in the world. To the best of my knowledge, these counts exceed anything ever documented on large aggregations of great whales. Both locations are well known to local and international wildlife tour operators who lead tours to these famed nursery sites. Mark Carwardine, who leads tours to Laguna San Ignacio in a series of emails in May 2015 to me noted that ‘...several hundred is normal during the winter breeding season....’. It would seem to me that for scientists and whale watchers, in search of great whale aggregations, Grey Whales in the lagoons of San Ignacio and Ojo de Liebre may be the top choice in the world, subject to the caveat that the number of whales simultaneously in the field of view may not be as many as when a Sperm Whale super-pod numbering over 40 individuals is encountered. It surprises me that the local and international whale watching companies and local tourism authorities do not brand it as the ‘Greatest Gathering of Great Whales’.



Grey Whales in the Laguna San Ingacio have become famous for shepherding their young towards boats filled with people. (c) Chris Breen

Humpback Whales



Humpback Whales are known to gather in feeding grounds and many whale watchers have seen groups in Alaska hunting using the famous bubble netting technique. However, the highest concentration recorded may not be in North America but in what Douglas P. Nowacek and others published in a paper titled 'Super-Aggregations of Krill and Humpback Whales in Wilhelmina Bay, Antarctic Peninsula'. In their paper published in April 2011, they reported on a super-aggregation of krill of the level which had been absent in the scientific literature for over 20 years. On 1st May 2009 they entered Wilhelmina Bay in the Western Antarctic Peninsula and recorded 149 sightings of 306 Humpback Whales in 65 km of line transect surveys with a density of 5.1 whales per square kilometre. They believe this density was the highest point estimate for Humpback Whales reported in the Antarctic. Whale watchers off British Columbia have reported encountering pods of Humpback Whales where individuals are all around them. However, at the time of writing I have not come across any technical papers, which suggest that more than a dozen are found in a pod.

Bowhead Whales

Bowhead Whales have a population that occupies the Eastern Canadian Arctic and West Greenland. There is another population as well between the Chukchi Sea and the Beaufort Sea, which winters in the Bering Sea.

Of the population mentioned first, Bowhead Whales are known to gather in large aggregations especially in Isabella Bay and Disko Bay in West Greenland. The Government of Canada's website for the Ninginganiq National Wildlife Area (accessed in June 2015) states '...Up to 100 Bowheads have been recorded at one time in Isabella Bay, making this the single largest known concentration for this species anywhere in Canada'. K.J. Finley in his paper in 1990 titled 'Isabella Bay, Baffin Island: an important historical and present-day concentration area for the endangered Bowhead Whale (*Balaena mysticetus*) of the Eastern Canadian Arctic' presented results that showed that 107 unique whales had been photographed between 28th -29th September 1996. The Bureau of Ocean Management published a study on 15th July 2013 titled "Bowhead feeding Ecology Study (BOWFEST) in the Western Beaufort Sea". In their summary of aerial surveys, the highest count was on 18 flight hours logged between 29th August to 18th September 2009. They had 102 sightings of 452 Bowheads. During a five year study, 762 unique whales were identified from photographs.

The second population of Bowheads referred to above occurs seasonally in the area from the Chukchi Sea to the Beaufort Sea. Carin Ashjian and others in a paper titled 'Climate Variability, Oceanography, Bowhead Whale Distribution and Inupiat Subsistence Whaling near Barrow, Alaska' published in 2010 report on aerial surveys conducted in August and September in 2005 and 2006. They reported aggregations of Bowhead Whales of between 50-100 in early September of both years. Sue Moore and others in their paper titled 'Bowhead Whales Along the Chukotka Coast in Autumn' published in 1995 reported single day counts of 76 and 50 Bowheads on 1 October 1992 and 3 October 1993, respectively. S.W. Landino and others in 1994 published a paper titled 'A Large Aggregation of Bowhead Whales (*Balaena mysticeus*) Feeding near Point Barrow, Alaska in Late October 1992'. On 19th October 1992, they observed 16 groups and 11 singletons, for a total of 104 whales over an area of 277 square kilometres. The largest single group contained at least 30 whales.

Baleen Whales of the Southern Hemisphere

Fin Whales

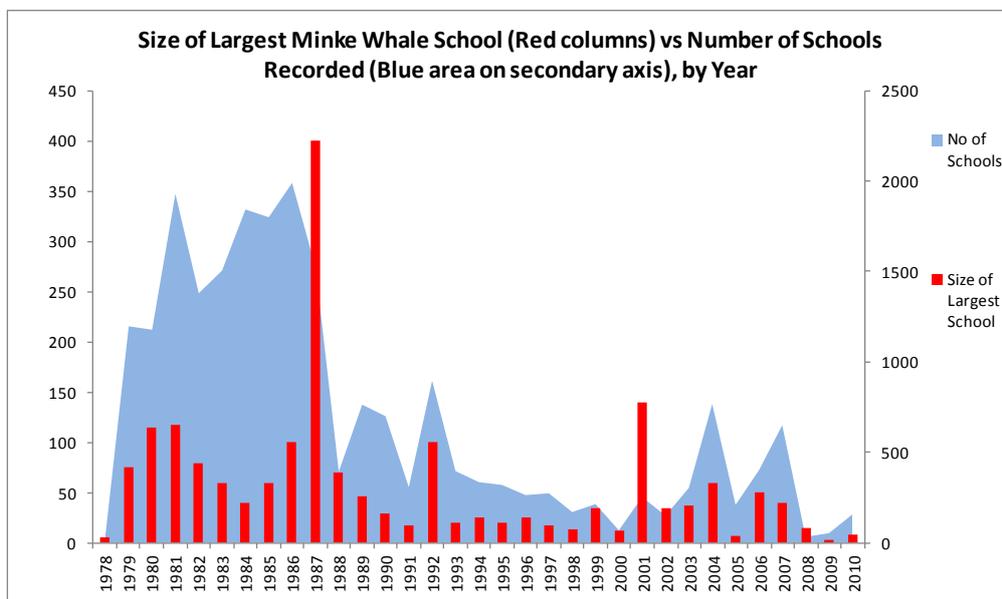
Fin Whales are occasionally recorded in large aggregations. Elke Burkhardt and Caterina Lanfredi in their paper 'Fall feeding aggregations of fin whales off Elephant Island (Antarctica)' noted that on 17 and 21st March 2012, a group of more than 100 Fin Whales was observed during a study that comprised of 26 days of surveys. The mean group size was four although they observed larger group sizes of over 20. These aggregations were the result of large Antarctic krill swarms. Jorge Acevedo and others in a paper titled 'Sighting of the fin whale in the Eastern Subtropical South Pacific: Potential Breeding Ground?' reported that they had encountered a group that may have numbered over 100. The sighting was 1,517nm off the continental coast of Chile on the 30th May 2010. The previous large concentration of Fin Whales in the South Pacific was a group of 50 on 4th November 1958 reported by Robert Clarke in his paper 'Whale Observations and whale marking off the coast of Chile in 1958 and from Ecuador towards and beyond the Galapagos Islands in 1959'. This sighting was estimated at '150 to 170 miles from shore'.

Antarctic Minke Whales

The phenomenal gathering of Grey Whales in Mexico is not to say that high concentrations of baleen whales do not occur in other parts of the world. Antarctica seems to be especially productive for great whales, probably as a result of the krill blooms that take place. Robert Pitman drew my attention to a reference of an aggregation of 400 Antarctic Minke Whales in the Encyclopaedia of Marine Mammals, 2nd edition by William Perrin, Bernd Würsig and J.G.M. Hans Thewissen. I investigated the question of how frequently the Antarctic Minke Whales in gather into large aggregations in Antarctica. From the International Whaling Commission (IWC), I received ship-based survey data on 22,468 Minke Whale schools, where Minke was the first or only species recorded. The data was logged on 1,237 survey dates in the period from 25th December 1978 to 27th August 2010; a span of thirty-three years. Schools were classified as distinct, if groups were more than about 0.3 nautical miles apart. On 17th January 1987, when the large count of 400 Minke Whales in a school was made, 32 other schools were also recorded with sizes ranging from one to five, with the majority being a school size of one (i.e. a single whale). It is clear that the estimate of 400 was on the same basis as others and is a real figure and not a statistical extrapolation. Most papers I have seen on Antarctic Minke Whales are of a statistical nature and the sizes of the large schools are lost in

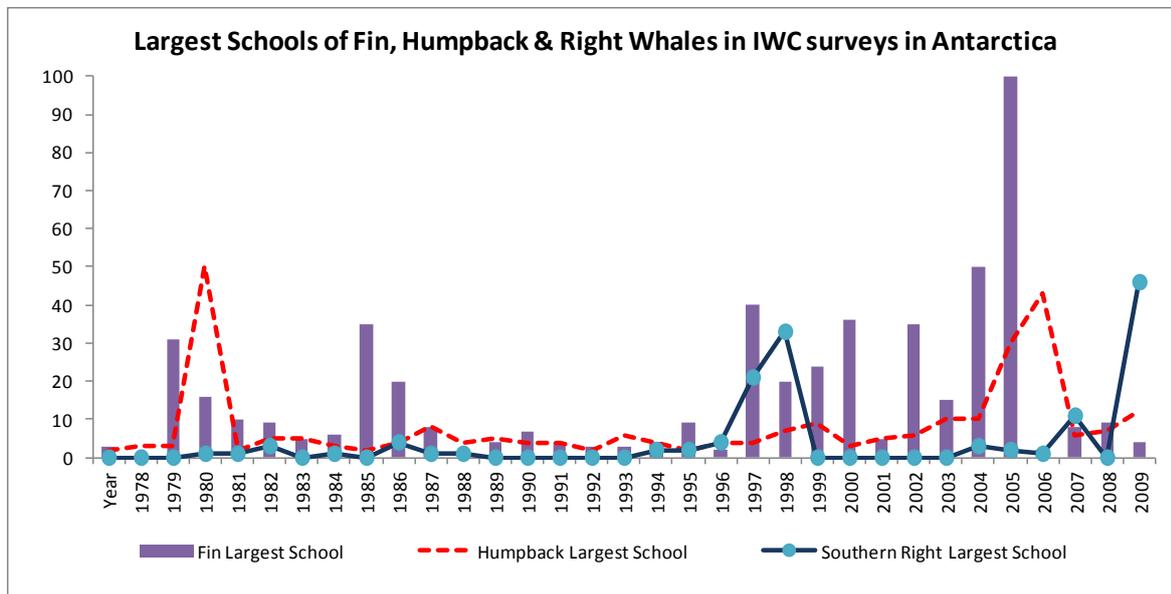
low-value arithmetic means which reflect that Minke Whales typically occur in small schools. The mean school sizes in all the years ranged between two and five.

The count of 400 Minke Whales was recorded only once in 1987. The next highest counts of over 100 Minke Whales were as follows: 140 (once), 120 (once), 118 (once), 115 (twice) and 100 (seven times). During email correspondence in May 2015, I also asked a few scientists for details of the largest 'in the field of view' counts they have had of schools of Minke Whales. The feedback I received included from Paula Olson ('...50-60 Minke Whales...') and Paul Ensor ('...Detections of large groups are also made from platforms other than the IWC research ships, for e.g. in Jan 2014, during helicopter surveys for Killer Whales in McMurdo Sound, I observed a group estimated at 60 individuals, all within 5 body lengths of a group member, and there were other groups in the area as well.....'). Minke Whales are not truly social animals but concentrate into large ephemeral gatherings for feeding. These concentrations are believed to have been higher nearer the pack ice. In dialogue with Trevor Branch and Mark Bravington, I gathered that the surveys moved away from the pack ice after 1984. Although the highest count was after this, it is possible that large concentrations in areas such as Prydz Bay close to the pack ice are now being missed. Antarctica seems to be very important for great whale concentrations of Minke Whales. However, this would not be evident from commercial whale watching cruises as they do not visit Prydz Bay in Eastern Antarctica. For example, Mark Carwardine who is a well-known author and populariser of whale watching has been to Antarctica around 23 times. However, he noted that he has not been to Prydz Bay and the largest school of Minke Whales he had seen had comprised of six whales.



I also received data from the IWC for Fin Whales, Humpback Whales and Southern Right Whales. I have shown the largest school sizes encountered in a single chart. The most notable is a school of

100 Fin Whales. Although Eastern Antarctica may in aggregate have the largest numbers of whales, it appears that to find large schools is difficult for these three species.



Dwarf Minke Whales

Dwarf Minke Whales are an undescribed sub-species of the Common Minke Whale found in the southern hemisphere. They aggregate in the northern Great Barrier Reef during the Austral winter. This is considered to be the only predictable, recurring aggregation of Dwarf Minkes and has led to a licensed swim with whales program since 2003.

The whales are usually in small numbers with the largest schools in the field of view that have been seen ranging from 12-15. The Minke Whale Project of James Cook University has maintained records of the number of whales estimated to have been seen during a day. These total counts for the day attempt to exclude re-sighting but cannot be exact. There are several reports each year of Dwarf Minke Whale schools with counts in the 20-30+ range, most in the vicinity of Ribbon Reef No. 10. During correspondence in August 2015 with me, Dr. Matt Curnock provided information on the largest estimates of total day counts of unique whales. The largest estimated counts were 50 plus whales on 24th June 2003 at Ribbon Reef No. 10, approximately 50 whales on 14th July 2009 at Cairns Section, a minimum of 46 whales based on photo ID on 7th July 2010 at Ribbon Reef No. 10 and potentially 100 plus whales on 24th June 2012 at Ribbon Reef No. 10. Although the arrival and aggregation of the whales is seasonally predictable and provide for wonderful interactions, the chances of whale watchers encountering a large school appears to be low.

Right Whales

Right whales are also reported in large aggregations. Ocean Alliance in their website state that for years they have studied a population of Right Whales which uses the bays of Peninsula Valdes as a nursery ground. They say the study begun in 1970 follows the lives of 2,600 individual whales. Maurico Failla and others in their paper 'Historical records of southern right whales (*Eubalena australis*) of the province Rio Negro, North Patagonia (1991-2008)' documented 308 records comprising of 425 whales. The mean group size was 2 and the maximum was 7. It seems unlikely that the Southern Right Whales are found in concentrations which rival that of the other great whales discussed earlier.

The North Atlantic Right Whale has been hunted close to extinction and only 400 are estimated to remain in the North Atlantic. The North Pacific Right Whale is rarely seen having also been pushed close to extinction.

Blue Whales

Blue Whales are not true social animals and are typically seen as individuals or in a mother and calf pair. They have until recent years been regarded as one of the hardest animals to see in the planet and not described in the scientific literature as being seen in large aggregations. In this article, I have shown that many of the baleen whale aggregations with the exception of the Grey Whales seem to occur unpredictably when there is a high concentration of krill. There are observations to suggest that in areas such as Trincomalee and Mirissa in Sri Lanka, there could be significant numbers of Blue Whales during the seasonal krill blooms. Not in the hundreds, but perhaps in aggregations no less noteworthy than what has been described for other baleen whales such as Bowhead Whales.

For example, on 24th April 2011 South of Mirissa I counted seven simultaneous Blue Whale spouts. At the same time, Dr. Charles Anderson, an experienced marine mammal observer was on another boat in the same locale and estimated that he had seen 17 individual Blue Whales in an approximately 5 kilometre square area (25 square kilometres). On 5th November 2010, Anoma Alagiyawadu, a Jetwing Lighthouse Hotel naturalist observed an astonishing 25 Blue Whales travelling together. At first, he thought it was a pod of Sperm Whales as he had never seen Blue Whales in such high numbers close to each other. Aerial surveys if conducted in the future may show that Blue Whales periodically gather in high concentrations off Mirissa and Trincomalee.

The Sperm Whale, the only Great Whale of the Toothed Whales



Sperm Whale in Kalpitiya, Sri Lanka. (c) Gehan de Silva Wijeyeratne

In the first section of this multi-part article, I posed the question of where the greatest gatherings of great whales occur and discussed various candidates amongst the baleen whales. Familiar whales such as the Blue Whale which feed by filtering water through baleen plates in their mouth are known as baleen whales. In this section of the article, I explore the subject of large gatherings which are reported for the Sperm Whale, the only toothed whale large enough to be classified amongst the great whales. In the first section of this article, I concluded that the greatest gatherings of great whales must be that of the Grey Whales gathering in breeding lagoons in North America. However, I also noted that as the whales are spread out, in terms of a visual spectacle, a super-pod of Sperm Whales, may be more spectacular. Sperm Whales are truly social animals, the elephants of the sea. However, encountering a super-pod is a matter of chance and in this second section of this article, I pick up their story.

Sperm Whales

In the Sunday Times (Sri Lanka) on 5th August 2012 I published the claim that Sri Lanka offers the best chance of seeing a super-pod (defined as more than 40 individuals) of Sperm Whales on a commercial whale watch. It leads to the bigger and more important claim that one of the biggest, recurrent, contemporary gatherings of great whales occurs off Sri Lanka.

The large gathering of Sperm Whales off Sri Lanka has not been recorded annually. But super-pods numbering over 40 individuals have just about been recorded each year since 2009. The large gatherings of over 250 Sperm Whales may not occur each year, or it may only last a few days each year and may be missed by the absence of observers. It will be hard to verify its annual occurrence unless more seasoned and attuned observers are out in the water or there is programme of aerial surveillance. I say 'attuned' because most local naturalists had failed to recognise the international significance of these super-pods and some records may have been 'lost' if it were not for conversation with me. Although large super-pods exceeding 100 Sperm Whales have been recorded in Mirissa in the South and Kalpitiya in the North-west, so far the large gatherings of over 250 Sperm Whales in a concentrated area have only been observed in Trincomalee in the Northeast of the island. The counts I refer to are only on surface counts as is the norm when reporting counts of whales.

These gatherings are probably the greatest ever known for Sperm Whales except for two previous observations published in 1839 and in 1946. In a letter to the editor of *Natural History* (55:96), W.D. Boyer, referred to an observation on 28th August 1945 off Peru at approximately 6 degrees South and 82 degrees West, near the Galapagos. This letter is also quoted in the prologue of Hal Whitehead's book 'Sperm Whales: Social Evolution in the Ocean'. It states '....approximately 400 to 600 whales were to be seen at one time from the centre of the school and it can be safely assumed that the entire school consisted of well over 1,000 whales.' The February 1946 issue of *Natural*

History also carried a comment to Boyer's letter by George G. Goodwin of the American Museum's Department of Mammals. Excerpts from his comments include '.... In recent years 30 or 40 of them would be considered an exceptionally large school of them...' and ' Thomas Beale stated in his *Natural History of the Sperm Whale* (1839) that he had one school of as many as five hundred or six hundred. The log books of whaling ships, so as far as I can learn, give no such stupendous figure.' Unfortunately, Beale provides no details in Chapter VI on 'Herding, and other particulars, of the Sperm Whale', in his book merely stating that 'I have seen in one school as many as five or six hundred'. R. A. J. W. Lever writing in the *South Pacific Bulletin* in 1954 in his article 'Whales and

Whaling in the Western Pacific' states that 'In the early whaling days, schools or 'pods' numbered up to 100, but extensive hunting in which nursing mothers and young were not spared, so reduced this figure to about 15'.

Hal Whitehead and his team of researchers have been studying whales in the Eastern Pacific near the Galapagos. There are no contemporary accounts of such large gatherings of Sperm Whales. In a conversation I had with Hal Whitehead in London on 29th August 2013, he told me that his research team has seen pods of Sperm Whales of 50-100. In an email to me on 15th April 2015, he commented 'I would note that there is a very good reason why there have not been enormous groups seen in the eastern tropical Pacific since Boyer's day. His observation was just before massive and largely unregulated whaling in the region (ca. 1948-1982)'.

The Sperm Whale Super-pods

In this final part of this multi-part article, I continue with the story of Sperm Whales and in particular on the super-pods recorded off Sri Lanka.



Above: The above image from Sri Lanka is not of a super-pod. But it still shows 14 Sperm Whales on the surface close together and gives an indication how spectacular it can be when over a hundred Sperm Whales are in the field of view.

The Sperm Whale is the great whale, which is typically a social animal and famed for large concentrations in the whale literature from the 19th to 21st centuries. It is the 'Elephant of the Sea'; females and immature males form breeding schools in the tropics and live in social units. However, in my article in the Sunday Times (Sri Lanka) I explained that the references in many popular books on whales, of thousands of Sperm Whales being seen together suggested as being normal is incorrect. This is an erroneous interpretation of Hal Whitehead's book where he estimates that

approximately 750 Sperm Whales may be found in a concentration spanning 300km and in discussing the impact of modelling assumptions states '.....while one 500km across would have about 22,000'. I suspect the discussion on modelling and the impact of assumptions on statistical measures have resulted in other writers misinterpreting that it is normal to see Sperm Whales in the thousands. The mean pod sizes listed in Whitehead's book range from 18 to 29.8. In conversation with him and other scientists and professionals in whale watching, I clarified that a pod of over 40 Sperm Whales is something special. Since then, inspired by my encounters with large pods of Sperm Whales in Mirissa, Kalpitiya and Trincomalee, I have been seeking data from whale watching guides and boat operators in Sri Lanka for continuing evidence of this claim.

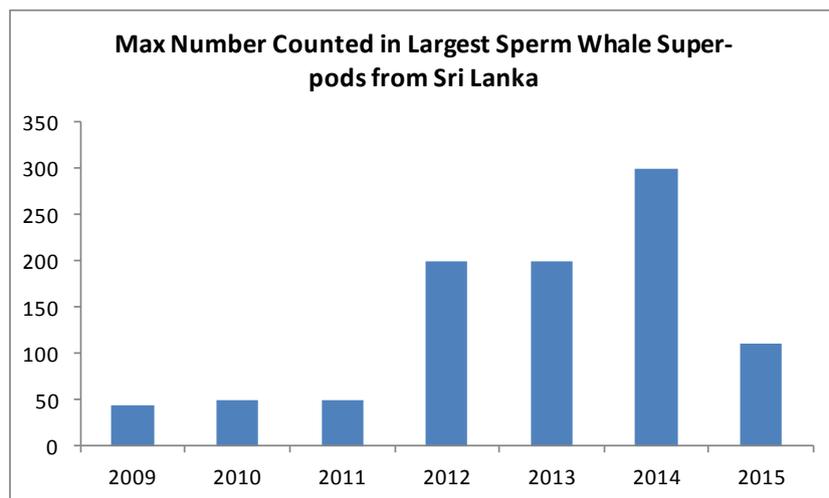
In addition to the annual super-pods, the key evidence so far of large gatherings off Sri Lanka is a Sperm Whale gathering recorded in March 2012 and another recorded on 29th September 2014. In 2012, a super-pod was observed between 8th March and 27th March, which had more than 40 individuals together during this period. Nilantha Kodithuwakku and Buddika ('Daya') Dhayarathne, two naturalists of Cinnamon Nature Trails who were resident at Chaaya Blue, a John Keells Hotel, took clients out to view and or dive with the whales. Client estimates varied, from Amos Nachoum estimating around 60-80 to Andrea Steffen, who has studied Sperm Whales off Dominica, estimating over a hundred. I had extensive face-to-face discussions with Nilantha and Daya on two separate visits to Sri Lanka to gain clarity on the March 2012 super-pod. They noted that on 4 days from 20th March to 23rd March 2012, the numbers on the ocean surface in the field of view peaked at approximately 200 to 250. This is a phenomenal concentration or gathering, as this was a surface count based on what they thought they could see around them.

Over two years later, on 29th September 2014, Daya encountered the largest aggregation of Sperm Whales he had ever seen with an estimate of over 300 Sperm Whales. I discussed this in detail with him by phone. He had travelled about 8km offshore from Trincomalee and then travelled around 13km towards Pigeon Island. He encountered 12-13 pods of Sperm Whales each containing 20-30 on the surface. Chitral Jayatilake who leads the team of Cinnamon Nature Trails naturalists arranged to fly out the next day to photograph this large gathering of Sperm Whales. Daya headed out to sea to locate the whales and relay the GPS coordinates, but the Sperm Whales were gone, although Daya did see an estimated eight Blue Whales on that day. Between March 2014 and September 2014, Daya had regularly encountered small pods of Sperm Whales at sea, up to the date of the large gathering referred to above. He speculates that the whales had gathered before moving out of the area together and he did not see them until March 2015.

The Sperm Whale super-pod data I have shows that super-pods occur regularly. These are summarised by month and location and by year and location in the accompanying tables. But note that the number of days seen is not the same as individual super-pods. The March 2012 super-pod in Trincomalee was seen on 20 days and may have comprised of many of the same whales although it is possible that in these gatherings there could be turnover of the specific individuals present from one day to another.

Sperm Whale Super-pod (> 40 whales)					
No of Days Seen. By Month and Location					
Month	Kalpitiya	Mirissa	Mullaitivu	Trincomalee	Total
January		1			1
March	4	4	1	25	34
April	5	4			9
May				2	2
September				1	1
November		1			1
December		1			1
	9	11	1	28	49

Sperm Whale Super-pod (> 40 whales)					
No of Days Seen. By Year and Location					
Year	Kalpitiya	Mirissa	Mullaitivu	Trincomalee	Total
2009		1			1
2010	1	1	1		3
2011		4		1	5
2012	5	1		20	26
2013	2	4			6
2014				4	4
2015	1			3	4
	9	11	1	28	49



The most significant super-pods besides the two already mentioned include the following: between 16th to 18th April 2013 in Kalpitiya a super-pod seen by various observers with some estimates over 100 but conservatively estimated at 70, on 9th March 2013 a super-pod estimated between 150 to

200 by various observers off Mirissa, on 12th March 2013 an un-confirmed report by fishermen (relayed by Ashan Seneviratne) of a super-pod of 200 in Kalpitiya (the count needs to be treated with caution; but may have been large and is noteworthy given the sighting in Mirissa a few days earlier), on 22nd March 2013 a super-pod of 100 off Mirissa relayed by Tony Wu who had an underwater image which showed 23 Sperm Whales in one frame, on 15th March 2014 a super-pod of 75 seen by Dr. Charles Anderson in Trincomalee, on 11th May 2014 a super-pod of 70 seen by Nilantha Kodithuwakku (conveyed by Georgina Gemmell) off Trincomalee, and on 24th March 2015 a super-pod with a surface count of 110 plus stragglers seen off Kalpitiya by a team including personnel from Whale and Dolphin Conservation (WDC). The last observation was released in social media as possibly the largest gathering of Sperm Whales seen in living memory and the count was estimated at between 350-500 (but this included whales estimated at being present under water). Based on the surface count relayed to me by email, this observation was more likely to have been on par with the super-pod of 16th -18th April 2013 in Kalpitiya. On the basis of comparable surface counts, it is not the largest seen off Sri Lanka or in living memory.

The significance of these large Sperm Whale super-pods can be seen in context in the following comments I received in response to my article in the Sunday Times (Sri Lanka) on 5th August 2012. Tony Wu, an award winning underwater photographer wrote to me on 8th August 2012. "I have seen groups of up to 20 or so animals in Japanese waters, but never up to 40-50 as you report. I talked with my friends who pioneered the Sperm Whale watching industry in Ogasawara, Japan, where I photographed the Sperm Whales eating giant squid. They have been observing Sperm Whales since the mid-90s in that area, and are probably the most experienced Sperm Whale people in Japan. They confirmed that they have only seen up to around 20 animals in a given group....". Michael Fishbach (Great Whale Conservancy) wrote on 5th August 2012. "I think I can clarify what you wrote about the Sea of Cortez and Sperm Whales. During my Blue Whale work there over the past 18 years the biggest pod of Sperm Whales I have encountered is an estimated 70. Amazing and unforgettable are two words I can associate with that encounter. The Azores is another location famed for its Sperm Whales. In a paper by Sara Magalhaes and others published in 2002 in the journal 'Aquatic Mammals' on reactions of Sperm Whales to whale watching vessels, they published details of pod sizes observed. In 69 land-based sightings, group size averaged 3.1 with the maximum being five. On 40 sightings in boat-based observations, the mean group size was again 3.1 with a maximum of seven. Compare this with Sri Lanka where super-pods are annually encountered which comprise of more than 40 whales.

The naturalists who take people whale watching off Sri Lanka are often pre-occupied with handling clients and it is possible that the numbers in super-pods are under-counted, or that when clients spend time with one pod of Sperm Whales, other pods in the close vicinity may be missed unlike in a scientific survey using a line transect method. But the two observations in March 2012 and in September 2014, together with the other observations, underline how important the waters off Sri Lanka are for large concentrations of these great whales. The large numbers present off Sri Lanka's waters are probably a result of the nutrient flows arising from upwellings from the two monsoons, nutrient flow from the Indian mainland and the 103 river systems in Sri Lanka. In February 2012, a team from the Ceylon Bird Club during an annual waterfowl census estimated over a million shorebirds from a single point of view in Mannar. This is probably the largest flock of migrant shorebirds counted from a single viewpoint. The nutrient dynamics which support large numbers of

wintering migrants are probably the same which support the presence of Blue and Sperm Whales in Sri Lankan coastal waters.

An analysis of 19th century whaling logbooks by Charles Townsend covering 1,665 voyages published in *Zoologica*, the journal of the Zoological Society of New York was accompanied by four charts, which showed the locations of where whales were hunted. This clearly shows that the New England whalers took Sperm Whales off Sri Lanka but not to the degree elsewhere. It is also possible that the Sperm Whale aggregations off Sri Lanka escaped the brunt of the 20th century whaling. However, the Northern Indian Ocean Blue Whales were subject to intense illegal Soviet whaling. Whether it was less whaling pressure or nutrient dynamics, or both, Sri Lanka is now a custodian of an important world heritage of great whale aggregations.

Conclusion

Let me conclude this multi-part article'. Although, in popular parlance there are references to large aggregations of Right Whales, Minke Whales, Humpback Whales and Bowhead Whales they do not seem to be occurring frequently enough, predictably enough and in large enough numbers to be a visual spectacle for it to be an wildlife tourism event. In terms of visual effect, a super-pod of Sperm Whales off Sri Lanka may well carry the biggest visual impact. However, this is not predictable enough to become a commercially viable wildlife event. The large aggregations of Grey Whales are predictable in timing of year and location and the tourism infrastructure is in place. The large aggregation appears to be spread out so that tourists are not confronted with the visual spectacle of a large gathering of large animals as with the Elephant Gathering in Sri Lanka where over 100 elephants are frequently in the field of view from a single point. Nevertheless, it seems that the Grey Whales of Laguna San Ignacio and Laguna Ojo de Liebre, best meet the description of the greatest gathering of great whales. In 2011, the magazine Wild Travel published a special issue on the '100 natural wonders that everyone should see in their lifetime'. The Grey Whale gathering in the nursery lagoons was missing. I suspect because there is no branding that there is no realisation that besides the amazing intimacy of being able to touch Grey Whales, in these lagoons are also the Greatest Gathering of Great Whales, which are annually recurrent and commercially viable for tourism. I would anticipate that for 'Conservation through Commerce' to work, this tagline will be adopted by those seeking to take tourists out there as well as those who need to raise grants for science and conservation.

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Papers consulted in the multi-part article on the 'Greatest Gatherings of Great Whales'

In this multi-part article in Wall Street International, I have sought to answer the question of where the greatest great whale gatherings have occurred or continue to occur. I consulted a number of people and read a number of scientific papers. The people who have helped me in various ways are mentioned in the acknowledgements. This multi-part series article will be a useful reference to media, whale watchers and others with an interest in marine biology. I have therefore included this supplementary bibliography which includes the citations of the papers I consulted.

Only papers which are relevant in the context of information on large, great whale aggregations are listed here. To make it easier for a non-scientific audience, the citations are grouped by type of whale rather than in the usual alphabetical manner in a formal publication.

Bowhead Whales

1. Born, E. W. and Heide-Jørgensen, M. P. (1983). Observations of the bowhead whale (*Balaena mysticetus*) in central West Greenland in March-May 1982. Rep. Int. Whal. Comm. 33, pp 545-547.
2. Hansen, R.G., Heide-Jørgensen, M. P. and Laidre, K. L. (2012). Recent abundance of bowhead whales in Isabella Bay, Canada. Journal of Cetacean Research and Management. 12 (3), pp 317-319.
3. Heide-Jørgensen, M. P., Laidre, K. L., Wiig, Ø., Postma, L., Dueck, L. and Bachmann, L. (2010). Large-scale sexual segregation of bowhead whales. Endangered Species Research, 13, pp 73-78.
4. Heide-Jørgensen, M. P., Laidre, K. L., Borchers, D., Samarra, F. and Stern H. (2007). Increasing abundance of bowhead whales in West Greenland. Biology Letters, 3, pp 577-580.
5. Landino, S. W., Treacy, S. D., Zerwick, S. A. and Dunlap, J. B. (1994). A Large Aggregation of Bowhead Whales (*Balaena mysticetus*) Feeding near Point Barrow, Alaska, in Late October 1992. Arctic, 47 (3), pp 232-235.
6. Moore, S. E., George, J. C., Coyle, K. O. and Weingartner, T. J. (1995). Bowhead Whales along the Chukotka Coast in Autumn. Arctic, 48 (2), pp 155-160.
7. Reeves, R. R. and Heide-Jørgensen, M. P. (1996). Recent status of bowhead whales, *Balaena mysticetus*, in the wintering grounds off West Greenland. Polar Research 15 (2), pp 115-125.

Fin Whales

8. Acevedo, J., O'Grady, M. and Wallis, B. (2012). Sighting of the fin whale in the Eastern Subtropical South Pacific: Potential breeding ground? *Revista de Biología Marina y Oceanografía* 2012, 47, pp 559-563.
9. Burkhardt, E. and Lanfredi, C. (2012). Fall feeding aggregations of fin whales off Elephant Island (Antarctica). IWC SC paper SC/64/SH9 (unpublished).

Gray Whales

10. Swartz, S.L., Urbán R., J., Gómez-Gallardo U., A., Martínez, S., Robles M, J.I., López, I.G. & Rojas-Bracho, L. (2013). Numbers of Gray Whales (*Eschrichtius Robustus*) utilizing Laguna San Ignacio, Baja California Sur, Mexico during The Winter Breeding Seasons: 2007-2013. Rep. Intl. Whaling Commission, Scientific Committee SC/65a/BRG06.

Humpback Whales

11. Anonymous. (2010). Advice relevant to the identification of critical habitats for north pacific humpback whales (*Megaptera novaeangliae*). DFO Canadian Science Advisory Secretariat Science Response, 2009/016. Fisheries and Oceans Canada Science.
12. Ashe, E., Wray, J., Picard, C. R. and Williams, R. (2013). Abundance and survival of Pacific humpback whales in a proposed critical habitat area. *PLoS ONE* 8(9):e75228.
13. Johnston, D. W., Friedlaender, A. S., Read, A. J. and Nowacek, D. P. (2012). Initial density estimates of humpback whales *Megaptera novaeangliae* in the inshore waters of the western Antarctic Peninsula during the late autumn. *Endangered Species Research*, 18, pp 63-71.
14. Nowacek, D. P., Friedlaender, A. S., Halpin, P. N., Hazen, E. L., Johnston, D. W., Read, A. J., Espinasse, B., Zhou, M. and Zhu, Y. (2011). Super-Aggregations of Krill and Humpback Whales in Wilhelmina Bay, Antarctic Peninsula. *PLoS ONE* 6: e19173 doi: 10.1371/journal.pone.0019173
15. Waite J. M., Dahlheim, M., Hobbs, R. and Mizroch, S. (1999). Evidence of a feeding aggregation of humpback whales (*Megaptera novaeangliae*) around Kodiak Island, Alaska. *Marine Mammal Science* 15 (1), pp 210–220.
16. Witteveen, B. H., Wynne, K. M. and Quinn II, T. J. (2007). A Feeding Aggregation of Humpback Whales *Megaptera novaeangliae* near Kodiak Island, Alaska: Historical and Current Abundance Estimation. *Alaska Fishery Research Bulletin*, 12 (2).
17. Fisheries and Oceans Canada. (2013). Recovery Strategy for the North Pacific Humpback Whale (*Megaptera novaeangliae*) in Canada. Species at Risk Act Recovery Strategy Series. Fisheries and Oceans Canada, Ottawa. x +pp 67.

Minke Whales

18. Branch, T. A. (2006). Abundance estimates for Antarctic minke whales from three completed circumpolar sets of surveys, 1978/79 to 2003/04. IWC SC paper SC/58/IA18 (unpublished).
19. Branch, T. A. (2014). Southern Hemisphere minke whales: standardised abundance estimates from the 1978/79 to 1997/98 IDCR/SOWER surveys. *Journal of Cetacean Research and Management*, 01/2001 (3), pp 143-174.
20. Hirohisa, K., Hidehiro, K., Fujio, K. and Yoshihiro, F. (1991). Detection of heterogeneity and estimation of population characteristics from the field survey data: 1987/88 Japanese feasibility study of the southern hemisphere Minke whales. *Annals of the Institute of Statistical Mathematics* September 1991, 43 (3), pp 435-453.
21. Kasamatsu, F., Ensor, P. and Joyce, G. G. (1998) Clustering and aggregations of minke whales in the Antarctic feeding grounds. *Marine Ecology Progress Series*, 168, pp 1-11.
22. Kasamatsu, F., Nishiwaki, S. and Ishikawa, H. (1995). Breeding areas and southbound migrations of southern minke whales *Balaenoptera acutorostrata*. *Marine Ecology Progress Series*, 119, pp 1-10.
23. Kelly, N., Peel, D. and Bravington, M. V. (2014). Distribution and abundance of Antarctic minke whales in sea ice regions of East Antarctica: a summary of results. IWC SC paper SC/65b/IA15 (unpublished).
24. Matsuoka, K., Ensor, P., Hakamada, T., Shimada, H., Nishiwaki, S., Kasamatsu, F. and Kato, H. (2003). Overview of minke whale sightings surveys conducted on IWC/IDCR and SOWER Antarctic cruise from 1978/79 to 2000/01. *Journal of Cetacean Research and Management*, 5 (2), pp 173-201.
25. Murase, H., Kitakado, T., Matsuoka, K., Nishiwaki, S. and Naganobu, M. (2007). Exploration of GAM based abundance estimation method of Antarctic minke whales to take into account environmental effects: A case study in the Ross Sea. IWC SC paper SC/59/IA12 (unpublished), pp 13.
26. Shimada, H. and Kato, A. (2005). Preliminary report on a sighting survey of Antarctic minke whale within ice field conducted by the Ice Breaker, Shirase in 2004/2005. IWC SC paper SC/57/IA7 (unpublished), pp 14.

Dwarf Minke Whales

27. Birtles, A., Valentine, P., Curnock, M., Mangott, A., Sobotzick, S. & Marsh, H. (2014). Report to the Great Barrier Reef Marine Park Authority on the Dwarf Minke Whale Tourism Monitoring Program (2003-2008). Research Publication No. 112. Great Barrier Reef Marine Park Authority.
28. Sobotzick, S. (2010). Dwarf minke whales in the northern Great Barrier Reef and implications for the sustainable management of the swim-with whales industry. PhD thesis, James Cook University.

Right Whales

29. Failla, M., Vermeulen, E., Carabajal, M., Arruda, J., Godoy, H., Lapa, A., Mora, G., Urrutia, C., Balbiano, A. and Cammareri, A. (2008). Historical records of southern right whales (*Eubalaena australis*) of the province Río Negro, North Patagonia, Argentina (1991-2008). IWC SC paper SC/60/BRG1 (unpublished).

Multi-Species

30. Anonymous. (2012). Known Biologically Important Areas for Cetaceans Chukchi Sea and Alaskan Beaufort Sea. Represents work done by Janet Clarke of Science Applications International Corporation, with review and revisions contributed by the Cetacean Mapping Working Group members.
31. Branch, T. A. and Butterworth, D. S. (2014). Estimates of abundance south of 60°S for cetacean species sighted frequently on the 1978/79 to 1997/98 IWC/IDCR-SOWER sighting surveys. *Journal of Cetacean Research and Management*, 3 (3), pp 251-270.
32. Clarke, R. (1962). Whale observation and whale marking off the coast of Chile in 1958 and from Ecuador towards and beyond the Galapagos Islands in 1959. *Norsk Hvalfangst-tid.* 51 (7), pp 265-287.
33. Ensor, P., Komiya, H., Beasley, I., Fukutome, K., Olson, P. and Tsuda, Y. (2007). 2006–2007 International Whaling Commission-Southern Ocean Whale and Ecosystem Research (IWC-SOWER) cruise. IWC SC paper SC/59/IA1 (unpublished).
34. Ensor, P., Minami, K., Morse, L., Olson, P. and Sekiguchi, K. (2008). 2007-2008 International Whaling Commission-Southern Ocean Whale and Ecosystem Research (IWC-SOWER) cruise. IWC SC paper SC/60/IA1 (unpublished).
35. Matsuoka, K., Hakamada, T., Kiwada, H., Murase, H. and Nishiwaki, S. (2005). Abundance Increases of Large Baleen Whales in the Antarctic based on the Sighting Survey during Japanese Whale Research Program (JARPA). *Global Environmental Research* 9 (2), pp 105-115.
36. Matsuoka, K., Watanabe, T., Ichii, T., Shimada, H. and Nishiwaki, S. (2003). Large whale distributions (South of 60°S, 35°E–130°E) in relation to the southern boundary of the Antarctic Circumpolar Current. eds Huiskes, A.H.L., Gieskes, W.W.C., Rozema, J., Schorno, R.M.L., van der Vies, S.M. and Wolff, W.J. *Antarctic Biology in a Global Context*. Backhuys Publishers, Leiden 3, pp 26-30.
37. Nishiwaki, S., Ogawa, T., Matsuoka, K., Mogoe, T., Kiwada, H., Konishi, K., Kanda, N., Yoshida, T., Wada, A., Mori, M., Osawa, T., Kumagai, S., Oshima, T., Kimura, K., Yoshimura, I., Sasaki, T., Aki, M., Matsushita, Y., Ito, H., Sudo, S. and Nakamura, G. (2007). Cruise report of the second phase of the Japanese Whale Research Program under special permit in the Antarctic (JARPA/JARPAII) in 2006/2007 –feasibility study- IWC SC paper SC/63/O4 (unpublished).
38. Scheidat, M., Friedlaender, A., Kock, K.H., Lehnert, L., Boebel, O., Roberts, J. and Williams, R. (2011). Cetacean surveys in the Southern Ocean using icebreaker-supported helicopters. *Polar Biology* 34, pp 1513–1522.