

Supplemental Material

We provide details on acoustic deployments, visual survey coverage, summarize the evidence dossiers used for vaquita research in 2019 and 2021 and give details on the population dynamics models. Full reports for both the survey (which contains details of acoustic deployments) and the expert elicitation including the full evidence dossiers for 2019 and 2021 are available at www.iucn-csg.org.

Text S1: Acoustic deployments and visual survey coverage

Twenty-nine out of 55 sites were selected to deploy acoustic detectors (C-POD), evenly covering the ZTA, on Oct 11, 2021 (Fig. S1 and Table S1, circles labeled 1 to 55). Replacement of acoustic detectors was attempted on Oct 14 and between 20-21, 2021. Retrieval of remaining acoustic detectors between Oct 23-24. During this period a total of 54 moorings were deployed or redeployed, 30 of them recovered and 24 permanently lost, presumably to theft in areas where high shrimp fishing activity was observed. Acoustic activity of vaquita was concentrated in the western portion of the ZTA. Seven moorings were deployed between Oct 25 and 29, during a neap tide cycle, when fishing effort was much less and winds were also high making this period likely to be safe from further detector loss. Deployment sites were chosen based on the higher detection rates found during earlier sampling. All detectors were recovered. Again, vaquita acoustic activity was concentrated in the western portion and hence visual effort to locate vaquitas was concentrated in this area.

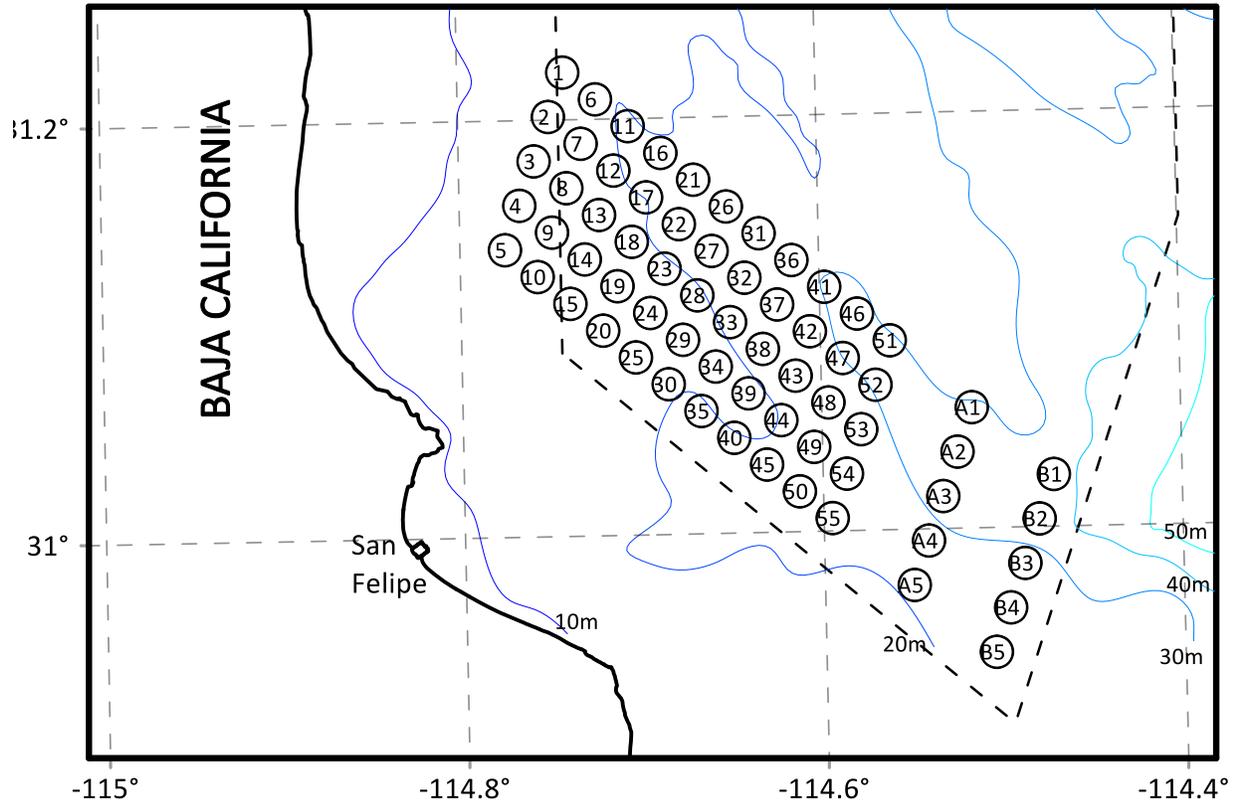


Fig. S1. Numbered circles were reference points corresponding with acoustic sampling sites inside the Zero Tolerance Area (distance between points is 2.48 Km in the north-south direction, between sites 1 and 2 for example; and 2.25 Km in the west-east direction, between sites 1 and 6 for example). Circles labeled A1-5 and B1-5 were additional points that could have been used to extend navigation transects toward southeast if needed. Bathymetry lines are included, for depths 10, 20, 30, 40 and 50 meters. Table S1 contains geographic coordinates of all points in decimal and degrees/minutes formats.

Table S1. geographic coordinates of points in Fig. S1 in decimal and degrees/minutes formats.

Sites	Lon (dec)	Lat (dec)	Lon (deg-min)	Lat (deg-min)
1	-114.74090	31.22277	-114° 44.454"	31° 13.366"
2	-114.74939	31.20159	-114° 44.963"	31° 12.095"
3	-114.75788	31.18041	-114° 45.473"	31° 10.825"
4	-114.76637	31.15923	-114° 45.982"	31° 09.554"
5	-114.77486	31.13805	-114° 46.492"	31° 08.283"
6	-114.72294	31.20959	-114° 43.376"	31° 12.575"
7	-114.73143	31.18841	-114° 43.886"	31° 11.305"
8	-114.73992	31.16723	-114° 44.395"	31° 10.034"
9	-114.74841	31.14605	-114° 44.905"	31° 08.763"
10	-114.75690	31.12487	-114° 45.414"	31° 07.492"
11	-114.70498	31.19641	-114° 42.299"	31° 11.785"
12	-114.71347	31.17523	-114° 42.808"	31° 10.514"
13	-114.72196	31.15405	-114° 43.318"	31° 09.243"
14	-114.73045	31.13287	-114° 43.827"	31° 07.972"
15	-114.73894	31.11169	-114° 44.336"	31° 06.702"
16	-114.68702	31.18323	-114° 41.221"	31° 10.994"
17	-114.69551	31.16205	-114° 41.731"	31° 09.723"
18	-114.70400	31.14087	-114° 42.240"	31° 08.452"
19	-114.71249	31.11969	-114° 42.749"	31° 07.182"
20	-114.72098	31.09851	-114° 43.259"	31° 05.911"
21	-114.66906	31.17005	-114° 40.144"	31° 10.203"
22	-114.67755	31.14887	-114° 40.653"	31° 08.932"
23	-114.68604	31.12769	-114° 41.162"	31° 07.662"
24	-114.69453	31.10651	-114° 41.672"	31° 06.391"
25	-114.70302	31.08533	-114° 42.181"	31° 05.120"
26	-114.65110	31.15687	-114° 39.066"	31° 09.412"
27	-114.65959	31.13569	-114° 39.576"	31° 08.142"
28	-114.66808	31.11451	-114° 40.085"	31° 06.871"
29	-114.67657	31.09333	-114° 40.594"	31° 05.600"
30	-114.68506	31.07215	-114° 41.104"	31° 04.329"
31	-114.63314	31.14369	-114° 37.989"	31° 08.622"
32	-114.64163	31.12251	-114° 38.498"	31° 07.351"
33	-114.65012	31.10133	-114° 39.007"	31° 06.080"
34	-114.65861	31.08015	-114° 39.517"	31° 04.809"
35	-114.66710	31.05898	-114° 40.026"	31° 03.539"
36	-114.61518	31.13051	-114° 36.911"	31° 07.831"
37	-114.62367	31.10933	-114° 37.420"	31° 06.560"
38	-114.63216	31.08815	-114° 37.930"	31° 05.289"
39	-114.64065	31.06697	-114° 38.439"	31° 04.018"
40	-114.64914	31.04580	-114° 38.949"	31° 02.748"
41	-114.59723	31.11733	-114° 35.834"	31° 07.040"

Sites	Lon (dec)	Lat (dec)	Lon (deg-min)	Lat (deg-min)
42	-114.60572	31.09615	-114° 36.343"	31° 05.769"
43	-114.61420	31.07497	-114° 36.852"	31° 04.498"
44	-114.62269	31.05380	-114° 37.362"	31° 03.228"
45	-114.63118	31.03262	-114° 37.871"	31° 01.957"
46	-114.57927	31.10415	-114° 34.756"	31° 06.249"
47	-114.58776	31.08297	-114° 35.265"	31° 04.978"
48	-114.59625	31.06180	-114° 35.775"	31° 03.708"
49	-114.60473	31.04062	-114° 36.284"	31° 02.437"
50	-114.61322	31.01944	-114° 36.793"	31° 01.166"
51	-114.56131	31.09097	-114° 33.678"	31° 05.458"
52	-114.56980	31.06979	-114° 34.188"	31° 04.188"
53	-114.57829	31.04862	-114° 34.697"	31° 02.917"
54	-114.58678	31.02744	-114° 35.207"	31° 01.646"
55	-114.59526	31.00626	-114° 35.716"	31° 00.375"
A1	-114.51641	31.05803	-114° 30.985"	31° 03.482"
A2	-114.52490	31.03685	-114° 31.494"	31° 02.211"
A3	-114.53339	31.01567	-114° 32.003"	31° 00.940"
A4	-114.54188	30.99449	-114° 32.513"	30° 59.669"
A5	-114.55037	30.97331	-114° 33.022"	30° 58.398"
B1	-114.47151	31.02508	-114° 28.291"	31° 01.505"
B2	-114.48000	31.00390	-114° 28.800"	31° 00.234"
B3	-114.48849	30.98272	-114° 29.309"	30° 58.963"
B4	-114.49698	30.96154	-114° 29.819"	30° 57.692"
B5	-114.50547	30.94036	-114° 30.328"	30° 56.422"

Visual survey coverage (Fig. S2) includes the on-effort trackline of both ships when Beaufort conditions were Beaufort 0-2.

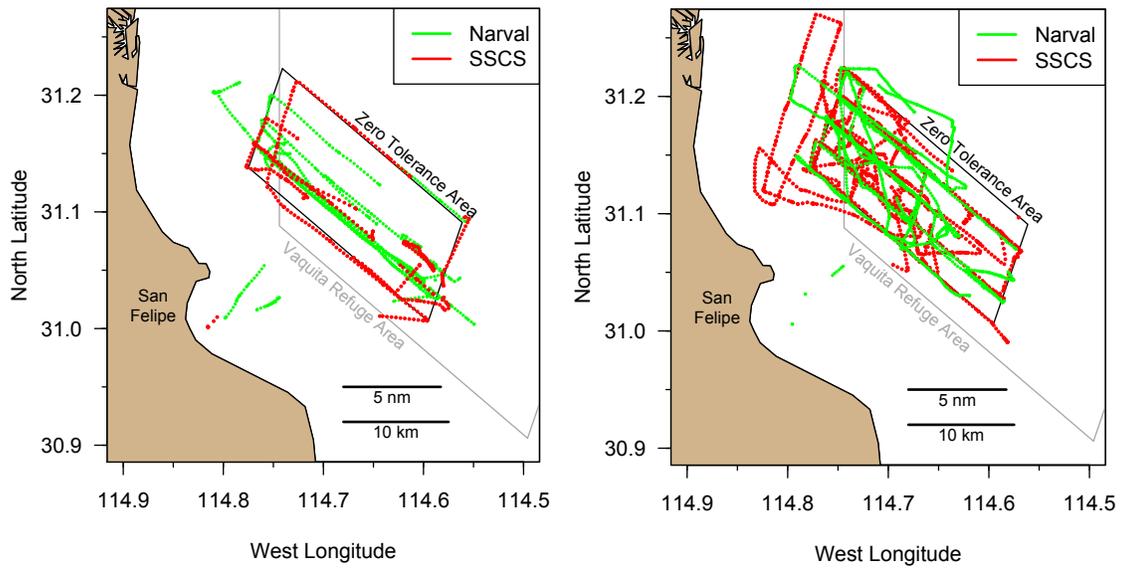


Fig. S2. Track lines followed during the survey in 2019 (left) and 2021 (right). The Vaquita Refuge is delineated with light gray line and the Zero Tolerance Area with a solid black line.

Text S2: Evidence dossier

We provide the full dossier for 2021 except the videos. The 2019 evidence dossier was lengthier because many high-resolution photographs were included as part of the evidence. Both dossiers start with the same background section. The dossier for 2019 was created after the field effort concluded once it was clear that a mark-recapture photographic estimate of vaquitas within the Zero Tolerance Area was not possible. Following the expert elicitation exercise in 2020, it was decided that creating the evidence dossier in the field was more likely to contain all the relevant evidence. The 2021 field effort was constrained to keep scientists on the two ships separate to minimize opportunities for spreading COVID. However, sightings were written up the day they occurred and shared electronically between scientists so that clarifications could be made while memories were fresh.

Evidence dossier for 2021 vaquita field research

General information on vaquitas and porpoise

The mean group size of vaquitas in all surveys (1997, 2008, 2015) was 2 (rounded to zero decimal figures). Although the winter period remains mostly unobserved, neonate vaquitas were recovered from early totoaba fishing in February. Thus, calves in October would be 6-8 months old, which is thought to be roughly the age of weaning. The individual marked below as C18 (Picture 1) was considered very likely to be a calf.

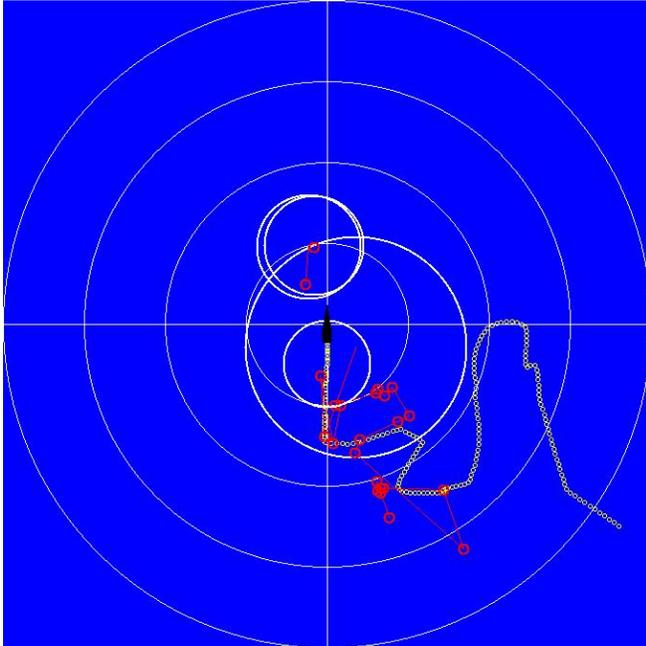


Picture 1. Photograph illustrating the relative size and position of likely mother/calf pairs in the fall survey period.

In the 2020 Expert Elicitation, the following definition was agreed for a calf: “While calves are biologically defined as less than one year old, age cannot be determined in the field. Therefore, inferences about whether an animal is a calf is determined through a combination of size (as compared to the other member of the pair) and behavior. Vaquitas in October are roughly 6 months old and therefore the size can be both small and only slightly smaller than the adult. The dorsal fin may appear only slightly smaller. Because of this, the behavior is also key. Dependent calf behavior is to surface within one body length and slightly behind the mother. With more time observed with a pair in this conformation (larger individual in the lead followed by a smaller individual within a body length), confidence that the pair is a cow/calf increases. However, because October is roughly the time of weaning, the calf can be expected to be more independent and may not always be in this position. The evidence dossier uses both the term ‘calf’ and the term ‘juvenile’. It is assumed that observers using the term ‘calf’ had confidence that they were observing the behavior above. Use of the term ‘juvenile’ indicates less confidence but definitely does not preclude that the smaller individual could have been a calf.”

Because calves are difficult to distinguish at 6 months of age, it is worth considering the likely range of probabilities that a distant pair seen fleetingly could contain a calf. For simplicity, consider that there are 10 adult vaquitas in the Zero Tolerance area and that all vaquitas are in

pairs. If half are females (5) and most are mature (4) and they had a calf every year then there could be 4 calves. If they had a calf every other year there would be 2 calves. So, a poorly seen pair has a non-zero chance of containing a calf and with the number given, the probability would be between .33 (2 of 6 pairs) and .57 (4 of 7 pairs).



Picture 2. Screen shot of ship (center) with ship's track (yellow circles) with vaquita locations (red circles). Each concentric centered circle is separated by 1 nautical mile.

The red symbols are the pair shown in the photograph from 2018 recorded in a WinCruz screen shot (Picture 2). The pair had a meandering pattern. Each of the regularly spaced, concentric circles is 1 nmi. (Ignore the bright yellow circles of differing sizes.) The total time of the sighting was 1 hour. The most distant points of this pair within the hour covered 4 nmi.

Conceivably if vaquitas travelled in a straight line, they could cover 8 miles in an hour, but more likely you wouldn't expect them to move more than what is seen here (about 4 nm).

In all surveys, sightings were mostly clustered meaning that single sightings were unusual and it was more typical to have a series of sightings in a relatively short period of time.

Notes for 2021

Even though there were only 8 (or possibly 9) sightings, it may be helpful to write each sighting down and draw lines connecting various sightings that could be duplicates to help with your final estimate of the plausible numbers seen. It may be helpful for each comparison to think “Can I rule out that this was the same vaquitas?” If not, there should be some probability that the sightings compared were the same, and some probability that they were different.

2021 Sightings: Each has basic data, observer narratives and as appropriate general comments, screen shots of the Wincruz Vaquita map and photographs or references to videos. Experts were allowed to see locations of vaquitas, but such locations have been removed from this document to protect vaquitas.

Observer eye heights: Sharpie 8.1m, Narval 7.7m.

At the end of this dossier is list of researchers.

OCTOBER 18

Viewing conditions: The Sharpie waited out high winds in the morning and early afternoon. At 3pm we began surveying in B3 conditions.

Sighting 1: Sharpie only

Photos: N

Videos: N

First time seen: 1648:28

Beaufort: 3

Swell: 2'

Last time seen: 1650:58

Beaufort: 3

Swell: 2'

Sighting length: 2 min

Our first sighting occurred at 1648 on 18 Oct 2021. We were closest to buoy 18, essentially between buoys 9, 18, 13 and 14 near the northern border of the ZTA, where pangas are numerous with shrimp gillnets. Viewing conditions were not great – B3 and swell of 2'. Ernesto Vasquez calls out the sighting from the right big eye binoculars at -6 and 0.8 reticles.

Ernesto Vazquez narrative: Initial sighting - observed one dorsal fin heading toward the ship (160°). It disappeared and a few seconds later saw the back and dorsal fin of a vaquita. It went down and a few seconds later, surfaced again and then dove and disappeared.

Chris Hoefler narrative: I was not on bigeyes, but I quickly got to fly-bridge and intensely scanned with my 400mm lens throughout Ernesto's observations. Between 60-80 seconds after last sighting by him (14deg left, approx.3rets), I thought I caught a glimpse of an end of surfacing in the "correct" spot given his observations. My glimpse was at approx. 20deg left and ½ to 2/3 nm. The wake was pushed in same observed direction of travel, approx. SSW, observed by him. I could not confirm this as a Vaquita, and it does not change group consensus of numbers. But given that it was very marginal conditions and only one bigeye was reliable (Beaufort was a low three), this animal or "group" was very poorly observed.

Additional notes during the sighting: the animal appeared “round” and healthy. It was traveling in a straight line. No way to estimate size but “it looked and acted like an adult”. Ernesto has confidence that it was not a calf or young animal.

OCTOBER 22

Sighting 2: Sharpie only

Photos: Yes, but not useful for size, position or identification

Videos: Y SSCS video_sightings 2 at 0814 and 3 at 1152_for observers_22-10-2021.mp4

First time seen: 0807:15

Beaufort: 3

Swell: 1'

Last time seen (last resight entered): 0817:21

Beaufort: 3

Swell: 1'

Sighting length: 10 min

Sharpie second sighting occurred at 0807:15 on 22 Oct 2021. We were running from line 5 to line 3 passing through buoy 30 on our way to buoy 28. The sighting occurred closest buoy 29. We were in a low B3, low swell, estimated at 1'. Felipe Triana calls out a triangular dorsal fin at 82 right, 1 reticle, on the big eye binoculars, heading in the opposite direction to us.

Felipe Triana narrative: Initial sighting 08:05 spotted on the big eyes @ 82 degrees right 1 reticle. I saw 2 dorsal fins (triangular in shape) one after the other, were seen traveling in the opposite direction as the Sea Shepherd (Southerly direction). We decided to turn to investigate

and try to confirm species. The Sea Shepherd turned 90 degrees right to close on the animals. After a few minutes of scanning, Chris spotted the animals and confirmed they were vaquita porpoise surfacing in a different direction (NW) or off to the port bow of the Sea Shepherd. They surfaced 3 more times traveling in the NW direction, animals looked similar in size but swam within one body length of each other one surfacing right after the other. The animals were very rapid staying above water less than a couple seconds. The last surfacing was witnessed at a closer distance (reticle 8) off the port bow by myself, Chris, and some Sea Shepherd crew, which were able to capture a photo and a short video. I had a good view of a vaquita at this distance on the big eye as it was beginning to arch to descend into the water. The photo and videos confirm species and group size estimate (2 animals). In the images, the animals don't look too different in size. Originally, I thought it was possible that it may be cow/calf because of the traveling distance between the two animals (less than a body length), but after reviewing the footage, I am more inclined to believe they seem to look more like two adults.

Chris Hoefler narrative: Felipe initially sighted at 82rt and not visible by me on port side bigeyes, highly likely only one surfacing of alternating animals that he said were heading to S. We turned and I subsequently picked them up for three surfacings; all three re-sights the pair was surfacing alternately (i.e. one coming up about 1.5-2secs after first but within about two body lengths consistently. The following animal was not in the "calf" position during my re-sights. It was more like the animals were fast traveling and remaining within about 1.5 body lengths during that travel. Both animals were high rolling and arching their peduncles at a fairly steep (steeper than usual) angle at end of each surfacing. This allowed for very good looks, and both animals

seemed to be full adults and the same size. For the three latter surfacings the animals were heading steadily to the NNW, almost in the exact opposite heading as the initial sighting.

Isidore Szczepaniak narrative: Felipe had the original sighting of 2 porpoise. After Felipe indication the location of the animals I saw them using hand-held binoculars. The 2 animals were 2 body lengths apart. The porpoises were both adults and appeared to be the same size. I saw them surface 3 times. They were moving from right to left.

Video 1 available from L. Rojas-Bracho on request

OCTOBER 22

Sighting 3 (A and B) : Sharpie (A) initially followed by Narval (B)

Photos: Y

Videos: Y SSCS video_sightings 2 at 0814 and 3 at 1152_for observers_ 22-10-2021.mp4

Sharpie narrative:

First time seen: 1141:22

Beaufort: 1

Swell: 0

Last time seen (last resight entered): 1159:44

Beaufort: 1

Swell: 0

Sighting length 3A: 18 min

Sharpie sighting 3A: Our third sighting was made at 1141:22 on 22 Oct 2021. Sergio sighted a single animal at 45 left and 1 reticle by cpod 9.

Sergio Martinez narrative: Initial sighting at 1141. I saw one vaquita twice at -45° and r-5, (triangular fin, and no scars visible) course 315. Viewing conditions were B1, maybe B2, and so I saw the animals very clear. Then Izzy confirms that he saw two animals, a few seconds later. When they come up to the surface I saw 2 vaquitas separated by around one body length apart and a third animal was separated about two bodies length apart, a few second later when they (3 vaquitas) come up to the surface, all of them were around one body length apart. They were traveling on a 270 course and finally a few seconds later, I saw two animals one of them smaller and in a calf position (at the right side from the adult, and just behind the adult dorsal fin. They also come to the surface twice. After that, we try to find them on the small boat, but we did not find them again from the small boat.

Chris Hoefler narrative: A single animal was reported by Sergio for several surfacings, and he was sure this was a solitary traveling animal. I picked it up visually as it was heading to a very significant convergence between turbid green water south-side and slightly more blue water north-side. Approx. 4 minutes later (approx. 0.5nm from solitary animal followed by Sergio), a pair of animals traveling tightly alongside this convergence south-side, green-side. One was possibly in the calf position, but they were too distant to gauge well body size and be sure of this. As this pair passed over the convergence slightly in to the blue water, they began surfacing often (i.e. every few to ten seconds) and were actively milling and slightly more energetic, slightly

higher surfacing. At this point, a third animal showed up (very likely Sergio's solitary animal that was approaching this area) fairly near the area but not quite within the same angle-camera focal area. I took several distant photos at this point of the pair (time stamp for best "mom-juv/calf" photos was at 11:59 local), and the animals seemed quite interactive. One of the media guys onboard also took some video footage at this point. We lost these animals briefly after they began moving along the convergence to the WNW roughly, and the Narval crew picked them up very close to where they should have been expected. I cannot say what was mentioned by that crew, but only a few sightings were seen at this point as the Narval's panga and the Sharpie's tender went in to the water to approach the area. It seemed very likely that we spooked the animals as both large vessels turned onto them, and we only had brief re-sights thereafter of a pair of animals (I believe).

Isidore Szczepaniak narrative: Sergio had the original sighting of 1 porpoise. Using the big eyes I initially saw 2 animals. One porpoise was larger than the other. I saw them surface 3 times and the smaller animal stayed on the right side of the adult. The pair surfaced synchronously with the smaller animal staying tight to the adult and their dorsal fins appeared at the same time.

Notes and observation from media: no good photo identification images but we have carefully examined the photos that Chris took and the video taken by SSCS. There are a series of 28 photos taken by Chris between 1157 and 1200, including the two photos appended to the dossier. There is also a brief SSCS video clip at 1150 – but the time on the video is 2 min slow compared to the time synch on our phones/WinCruz – so the time of the video should be 1152.

Video 2 available from L. Rojas-Bracho on request

We discussed the video for a long time, frame by frame, and enlarged; and ran the video alongside the photos. There are four surfacings. Two of the surfacings were of a single individual. Two of the surfacings were of a pair of individuals. We asked the following questions:

How many individuals? Four people concluded 3 animals. Three people say there may have been 2 animals, with varying degrees of certainty (3 vs 2 animals: 60:40, 40:60, 40:60).

- If it is three individuals – a single adult-sized animal is surfacing twice and the presumed mother-calf pair is surfacing twice. If this is the case there should be three distinct dorsal fins. We drew composite images of each of the three dorsal fins based on the descriptions of the observers. There is clearly one animal with a broad triangular fin. A second, and possibly, a third darker individual has/have more pointed, and falcate, dorsal fins. Per above, no one was 100% certain that the individuals surfacing with the more pointed fins was the same or different; both seemed possible, most considered the pointed fin animals to be different individuals. We drew three distinct fins, but the two pointed ones ... could be the same animal.
- If it is just two individuals – one of the pair is surfacing 4 times, twice alone and twice with the other individual. This is unusual and would be a high breathing rate for a single individual in the course of the short sequence.

Is there a mother-calf pair? Most all seemed confident that there was a mother-calf pair in the photo.

This conclusion is based relative size of the two individuals. One appears to be a larger animal with the gray triangular dorsal fin and the other smaller, with a smaller more falcate dark dorsal fin.

Chris Hoefer's photographs

Five minutes later, Chris took a series of photographs. We carefully looked at the size and shape of the fins.

Best photo of the what we think is the individual animal (Sergio's original individual) is shown in frame #1765 @1157 in the blue water (Picture 3 but see also Fig. S4 from video). Most observers think this photo is a single animal, and different from the two in the following frame (Picture 4). It has a tall and pointed fin. Chris took frames before and after this and there is no other animal in these frames.

Best photo of presumed mother-calf pair frame #1775 @1159 also in the blue water (Fig. S2 and Fig. S4). The presumed mother has a distinctly broad, triangular fin. Perhaps a faint indication of a bulge? The fin and body appear pale in both the video and Chris's photo. The presumed calf appears darker in body and fin color. The dorsal is smaller than the other animal's, and distinctly narrow at the tip.

Summary of the discussion: The strongest evidence for the Sharpie comes from the original accounts of the observers on the big eyes, who saw one animal and a presumed mother calf pair come together. They had good views and were relatively close (reticle 5/6). The photographic evidence (photos and video) for most of the group leans to three, but there was not a definitive way to tell if the animal/s with the pointed fins were the same or different. Similarly, most lean to there being a mother-calf pair in the sighting, due the description of the observers on the big eyes and their interpretation of one animal being smaller in body size and dorsal fin from the photos and video, but again, there was uncertainty around this. Importantly, however, was the subsequent discussion of sightings 4 and 5, which all seemed to agree were of the same sighting as 3. If so, and there were three animals including a mother calf pair in sighting 3 but only 2 animals in sighting 4 and 5 then where did the calf go? Alternatively, this meant that there might have been another pair in the area. These uncertainties were captured in the cumulative totals for the group.



Picture 3. CJH_1765 cropped probable solitary animal @ 1157



Picture 4. CJH_1775 cropped probable mom calf pair @ 1159.



Picture 5. Still captured from video of first animal seen in sighting 3.



Picture 6. Still captured from video of pair seen after the surfacing shown in Fig. S4.

Narval narrative:

Note from the Narval: (presumed) resight of Sharpie sighting #3 and called here **3B**. Two individuals were seen, they see no indication they are different sizes.

No photos or video from the Narval.

Data

First time seen: 1149:54

Beaufort: 2

Swell height: 0

Last time seen: 1207:21

Beaufort: 2

Swell height: 0

Sighting length 3B: 18 min

Sighting length 3A+3B: 26 min

Sergio had sighting 3 from the Sharpie and the Narval was called over.

For the descriptions below, all noted that the animals were swimming along a current line that marked a water color change and had foam. There were 3 western grebes and a distinctive black 2-foot-long log nearby.

Bob Pitman narrative: 11:49:54: Bob Pitman resight of Sharpie sighting #3. The animals were sighted up ahead of us in the general area where we were expecting sighting #3 to resurface. We assumed that this was the same sighting but could not verify 100%. I saw two animals traveling moderately fast to the right. Viewed perpendicular, the lead animal had a robust dorsal fin with a slight bulge to the leading edge; presumably an adult. I barely glimpsed another animal beside and slightly behind it about one body length and on the left side. Behavior suggested a cow/calf pair but I didn't get a good enough look to be certain of the size.

At 12:07:21 I saw what I believe to be the same two animals as above, traveling close together, two more times and heading in the same direction as previous. When last seen, the pair arched up and sounded – it appeared that they might have been foraging. The decision was made to go out in the panga to try for photo-identification shots.

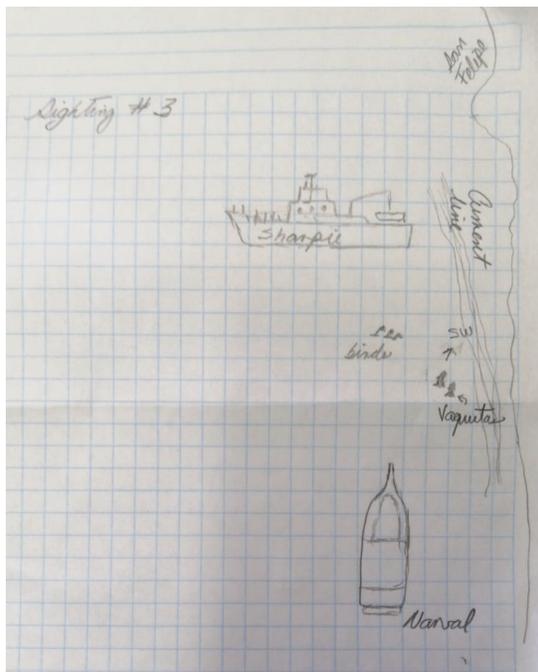
We did not see these animals again from the panga. We did not see the next two sightings from the panga (004 and 005).

After seeing the video I think the pair I saw was the same as the closely associated pair in the video.

Juan Carlos Salinas narrative: 1201:45 Juan Carlos resights with hand-held binoculars.

Sighting # 3 was originally seen by observers on the Sharpie, (about 1143:48) then few minutes later (11:49 am) some animals were sighted by Bob (004) at 11 left and 0.8 ret on the Narval one

animal and maybe two were heading to the right (of the Narval's bow). After some minutes the observers on the Sharpie called to say that the last sighting position was on their port beam. Moments later I saw two animals swimming with a SW direction, about one or two body lengths apart from each other. They seemed to be very similar in size (adult size) and at a distance, the dorsal fins looked clean and similar shaped. However, the animals were swimming away, so sizes are questionable. Almost immediately Mark W. (observer # 031) saw these animals for a few surfacings (3 times?) at 17 deg to the right of the ship's bow and 4 Reticles, he also called two animals seen at the surface in the same field of view, both similar in size. At this point the animals were swimming near a current line. Bob (004) saw a high roll and said that maybe was a good time to launch the boat to attempt to approach the animals close enough for ID photos. The boat was deployed but the animals were not seen again in the area. At 1233 we decided to move forward and resume searching with a SE direction until 1250 when we turned around 180 deg. back to the general area were last seen.



Drawing 1. Juan Carlos' drawing of positions of items mentioned in his narrative for sighting 3.

Marc Webber narrative: 12:02.45 Two resights of sighting 3 logged at this time. At 8° left, 2.2 reticles I sighted the group I believe Bob and then Juan Carlos saw. There were two animals in my view that were moving left to right just on the near side (from our view) of a slick line with light tan foam. The two animals were about the same size with about the same size dorsal fin. I do not think they represented a cow and a calf. Both dorsal fins were erect and nearly triangular with no obvious markings such as nicks.

They surfaced almost synchronously with the lead animal surfacing just a moment before the trailing animal, and all 4 surfacings in the surfacing series, both surfaced in this pattern. Neither animal was in any kind of calf position with respect to the other (alongside at the dorsal fin area or slightly behind as done by harbor porpoise). They were in a lead-and-close-follow formation and were not superimposed on each other from my near perpendicular view.

The same group of two were sighted a second time on the near side of the same slick area. They were sighted on a further bearing to the right and moving left to right. All observations about the animal's size, fins and their positions relative to each other are basically the same.

12:05.46: 12° degrees right and 3.4 reticle. I believe this is a resighting of the same two vaquita as noted above. Both animals were again moving left to right on the near side of the slick system. All characteristics of surfacing, position of animals relative to each other, size of animals and size and shape of the dorsal fin are the same.

12:07.21: Resighting of the same two animals, 17° right 4 reticles. I am confident that this sighting was of the same two animals I observed at 12:05.46. All observations about the animal's size, fins and positions near each other are basically the same as the previous three views. I did not see any evidence of a third animal surfacing with the two, or a smaller animal with the two.

Jay Barlow narrative: After Bob first saw the group from the Narval, I spotted it with 8X binoculars on a stick. I saw two surfacings of at least two animals in each surfacing (maybe three). They were far away, maybe ½-¾ miles, and were very small images in the binoculars. Two appeared to be similar in size. The third (if real) was more of a perception than a confirmed sighting. Best High Low= 2,3,2. They were moving from left to right (towards the South, I think).

The figure below shows the tracks of the ships and the locations of 3A and 3B. At the times of their sightings, both ships had completed turns. The Sharpie was on a steady course of 132 so the position of sighting 3A should be accurate. The Narval had not yet steadied up, so the ship's heading, and therefore the position of sighting 3B is less certain. The gray dots represent a range of reasonable positions of sighting 3B.

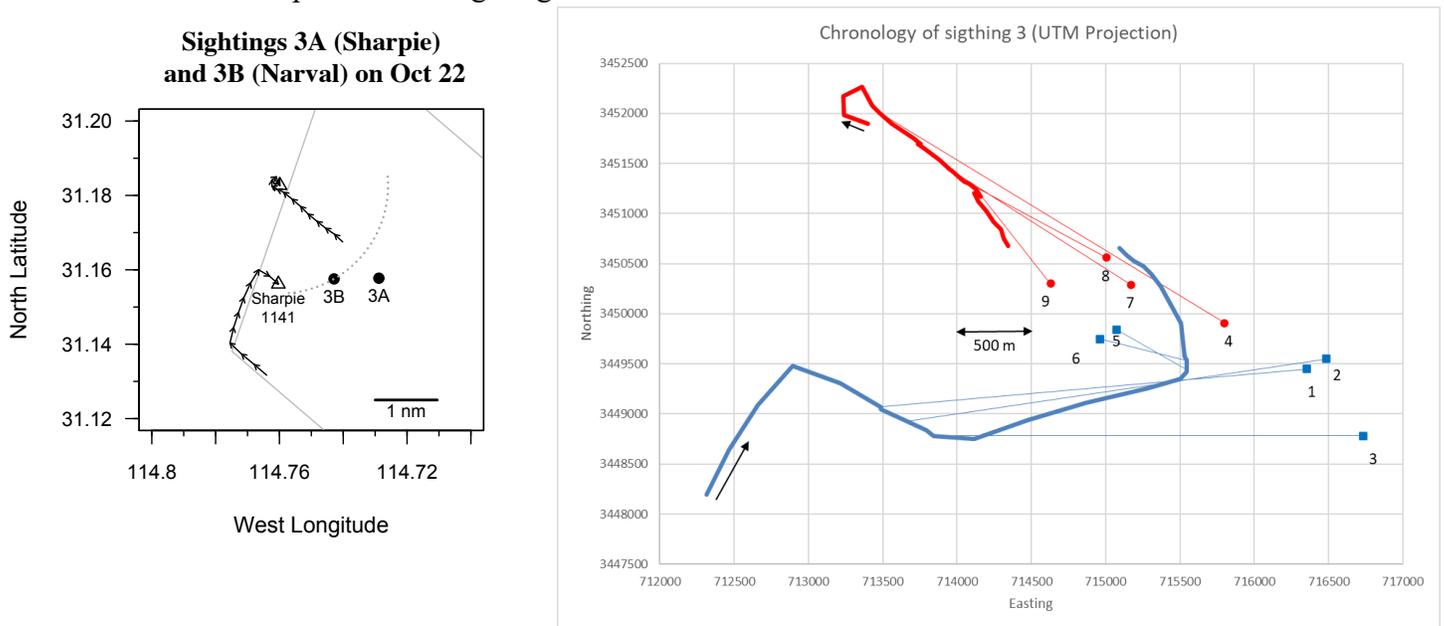


Figure S3. Positions for sighting 3.

OCTOBER 22

Sighting 004: Narval only

Photos: N

Video: N

Data

First time seen: 1322:49

Beaufort: 3

Swell height: 0

Last time seen: 1340:10

Beaufort: 3

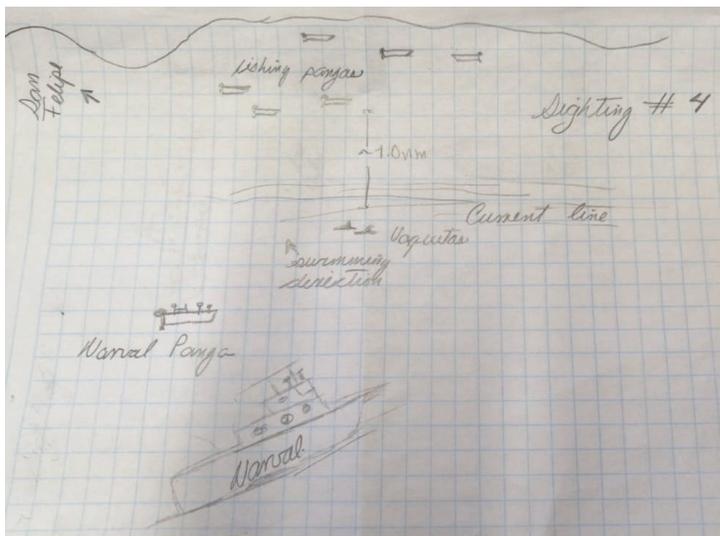
Swell height: 0

No photos or video from the Narval.

Sighting length: 18 min

Juan Carlos Salinas narrative: I saw two animals while we were heading back to the general area of sighting # 3. They were swimming slowly in a SW direction.

The animals were of similar size, and no distinct marks were seen on dorsal fins, but did not have opportunity to observe long enough to see the shape of the dorsal fins. This sighting was about 2.2 nm from the sighting # 3. These animals were swimming also along side of a current line that marked a color change and had foam, maybe 200 or 300 mts. distant. There were 3 western grebes and a distinctive log nearby. Several fishing pangas (about 5 to 7) with gear on the water were seen, about 1 nm away from this sighting. The panga was still on the water and was directed to the area of the animals but they never saw these animals. At 1340 I saw two animals about 0.5 nm away from my original sighting (#4) position but heading to the NE, and again about the same size and maybe one body length apart from each other. So, the direction of travel changed almost 180 degrees. They were last seen heading towards the Sharpie (see illustration). The animals were not resighted again, but the observers on the Sharpie reported two animals (sighting # 5), several minutes later. These animals were in the same general area of sighting # 3 associated to a some current lines heading to the vicinity of the Sharpie.



Drawing 2. Juan Carlos' illustration of sighting 4.

OCTOBER 22

Sighting 5: Sharpie only (23 minutes after Sighting 4). Note that the Sharpie was called over to where Sighting 4 was to help tracking.

Photo: N

Video: N

First time seen: 1405:10

Beaufort: 1

Swell: 0

Sighting length: 2 min (no last time seen because it was not resighted)

This sighting, which we are calling sighting 5 was made at 1403 on 22 Oct 2021 by Sergio Martinez at 45 left and 6 reticles between cpods 3 and 2 (just outside ZTA). The animals were seen twice. Operator issues with WinCruz messed up the mapping function.

Sergio Martinez sighting narrative: Initial sighting - 14:03 I saw two vaquitas one behind the another at -45 and r-6 course 315 or 320. Less than one body between them, they come up to the surface twice at the same time, the vaquita at the front it was an adult, but the one at the back I'm not sure about the size. This sighting was in the same area where the Narwal had the sighting 4 and a few minutes later, so It's possible that it is the same sighting. For the vaquita position it was not possible to see the dorsal fin shape.

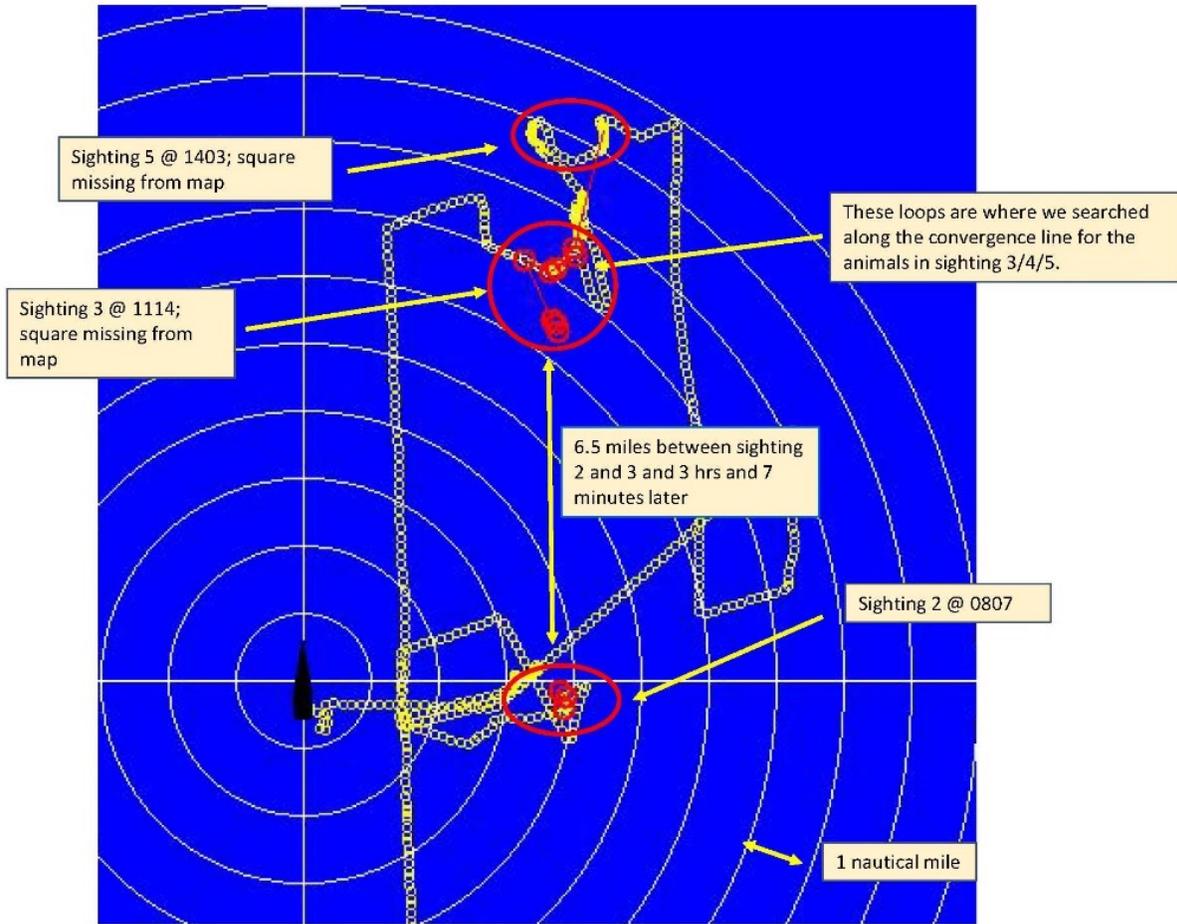
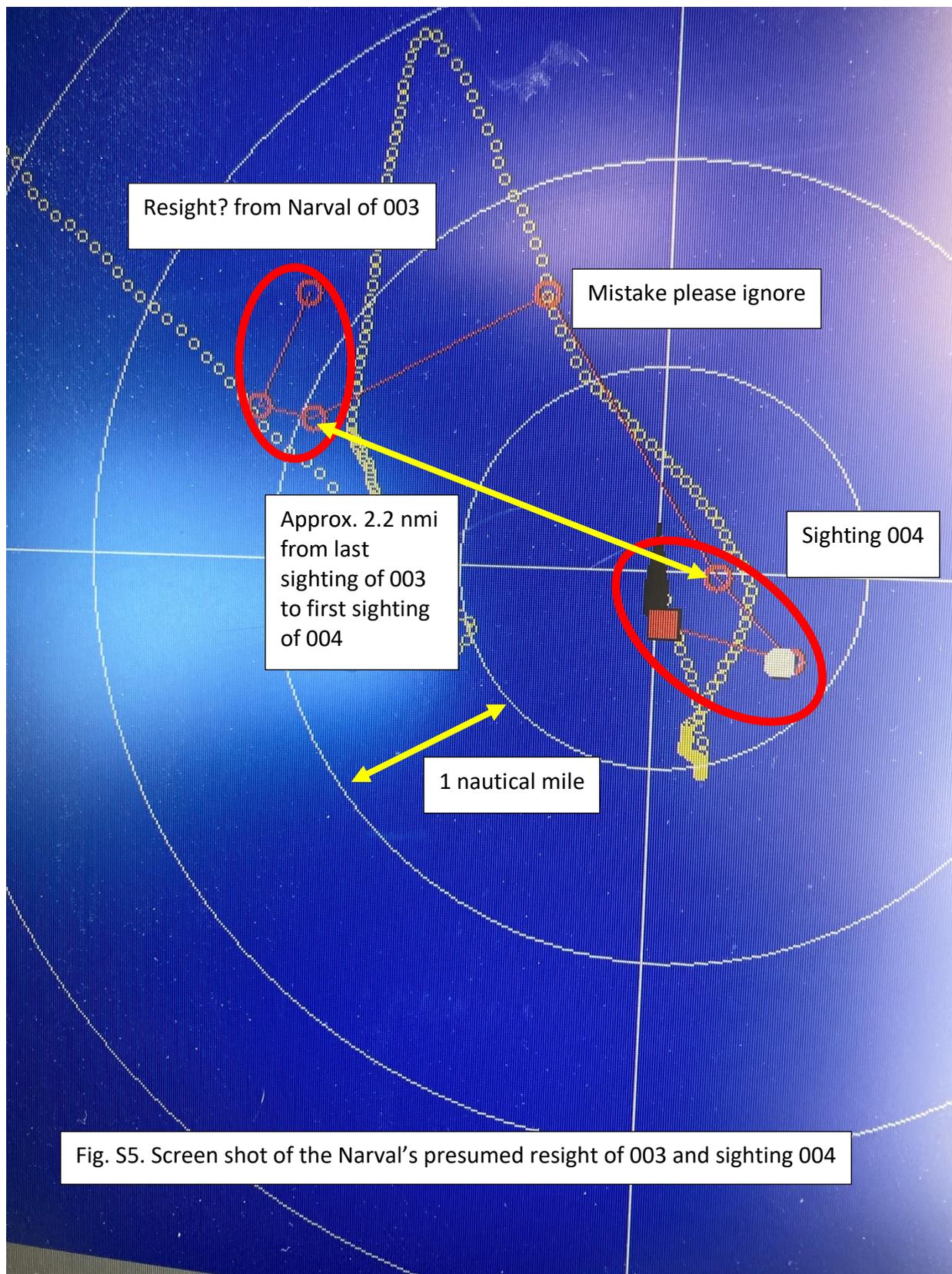


Figure S4. Trackline for Sharpie on 22 Oct 2021



Case # 1. last position for sighting 2 and first position of sighting 3

Case # 2. Narval resight of 3 at 120721 and Narval sighting of sighting 4 at 132249

Case # 3. Narval resight of sighting 4 at 134010 and Sharpie sighting 5 at 140510

Case Time.hr Distance.nm. Speed.knots.

1 3.4002778 5.4 1.6

2 1.2577778 1.8 1.5

3 0.4166667 1.2 2.9

Potential movement of animals between sighting areas 2 and 3 under favorable tidal current. The last observation of sighting 2 occurred at 08:17 (blue cross in figure below) and the first of sighting 3 occurred at 11:41 (red cross). The distance between points is 11.1 Km, hence, if are the same animals, traveled this distance in 3.4 h for a speed of 3.3 Km/h.

Low tide occurred at 08:46, so tidal current was operating in approximately northwest direction as tide was going up (blue lines in right panel below show the times between sights 2 and 3).

Hence, tide could help animals in moving between areas of sighting.

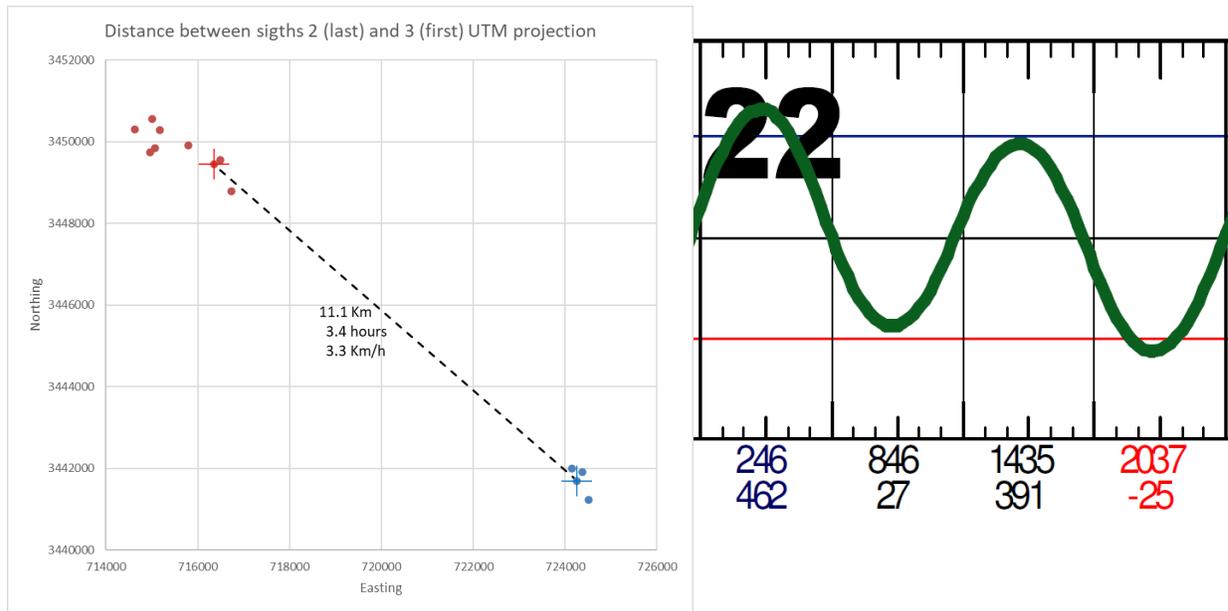


Figure S6. Tide and distance values to calculate potential vaquita swim speeds.

23 Oct 2021

Sighting 6: Sharpie only

Photos: N

Videos: N

First time seen: 1307:38

Beaufort: 3

Swell: 2'

Last time seen: 1331:40

Beaufort: 3

Swell: 2'

Sighting length: 24 min

We begin the day in B4 conditions at anchor. The weather begins to improve and we make our way to the tracklines. We start effort in B3 conditions with a 2' swell at 1231. At 1307, Chris Hoefler has a distant sighting, which he initially detects as Tursiops. We enter this as an object (object 2). Izzy resights (object 3), and then Chris (object 4), and then both Chris and Izzy are on the same animal (object 5). As the sighting progressed, and we move closer, it became clear that we had a vaquita sighting. We got a firm ID at 1331, entered as sighting 6. Estimating from the screen, from the time the first object was recorded to the time sighting 6 was recorded, 24 minutes passed and the animals continued traveling in a straight line to the southwest. This trajectory would have taken them outside the ZTA. We searched ahead, back on our tracks and around, but did not resight them.

Chris Hoefler Sighting narrative: Initial sighting - First seen by me distantly at 12 left and 0.6 reticles; the pair was much distorted in the haze/heat waves for the first 3-4 surface intervals. They were so distorted that I thought they were Tursiops initially. But all subsequent surface intervals revealed small, sneaky animals. It was not until the last re-sight that I confirmed them to be Vaquita 100%, i.e. very small bodied with disproportionately large, triangular fins. All together we witnessed 6 surface intervals, and the pair low and slowly rolled tightly together for all intervals, each interval included two surfacings. They were re-sighted accurately on the more stable, starboard bigeyes several times, and were always heading to the SW or SSW. Last sighting was when the Sharpie went to steerage, but the ship managed to maintain the heading more or less. Last re-sight was at 1331 local, 124 right, and 3.7 reticles. The animals were still tightly together and heading to the SW in the glare. I could not get a good look at the far-side

animal as it was always obscured by the closer animal. At one point during third surface interval, I thought I could see that the far-side animal was very similar size to the nearer one. But I am not sure about this at all.

Izzy sighting description - Chris was on the right “big eyes” and I was on the left ones. Chris had the initial sighting. I spotted the porpoises a few minutes later. I had 2 sightings of 2 porpoises. Both porpoises were adults and the same size. In the first surfacing sequence the 2 animals surfaced 3 times. All 3 times the animals surfaced together. The second surfacing sequence the animals surfaced twice, again surfacing together. The dorsal fins of the 2 animals were robust, wide at the base. I could not see if there was a bulge on the anterior portion of the dorsal fin.

Monday 25 Oct

Sighting 7 Narval

Photos: N

Videos: N

First time seen: 09:43:54

Beaufort: 2

Swell: 2'

Last time seen: 10:00:35

Beaufort: 2

Swell: 2'

Sighting length 16 min

R. Pitman narrative:

09:43:54 first sighted – closest to c-pod #44, 1 ret, 17° left (a c-pod was being deployed and the boat was spinning during the sighting).

Appeared to be traveling, headed SSW; saw one animal surface 3 times; not 100% because I did not see dorsal fin in very bouncy, heavy swell, but was easily missed as the animal passed quickly through my vertical field of view each time. Surfacing behavior, however, very vaquita-like: smallish animal, dark, a series of three quick rolls, each 5-6 secs apart.

09:59:06 resight – seen for another three surfacings, headed straight away from us, in the glare; two lower surfacings and then a higher arch on the last. No dorsal fin seen again but the animal was headed straight away in the glare. Slight possibility of a second animal, but no more than one seen at one time in either of the two surfacings. Almost certainly one animal.

10:00:35 last seen (sounding arch). We stayed in area another 30 min or so and called in the Sharpie, but we did not see the animal again. 1 vaquita, 90% certain of identification.

Tuesday 2 Nov

Viewing conditions: The Sharpie was enjoying the best weather conditions of the trip. We were relishing the B0 winds, calm seas, no swell. It was vaquita weather.

Sighting 8

Photos: No

Videos: Yes, very distant

First time seen: 1654:16

Beaufort: 0

Swell: 0'

Last time seen: 1708:28

Beaufort: 0

Swell: 0'

Sighting length: 14 min

Sharpie narrative: Our 8th sighting occurred as the sun was getting low on our last day of survey. Viewing conditions were perfect when Felipe called out that he had an animal. An object was entered into WinCruz, and a second object, when resighted. It was soon confirmed by both observers on the big eyes, both saw only a single animal. Izzy also saw a single animal in the handhelds for one surfacing. Both Felipe and Sergio commented that the animal was small in size. Subsequent surfacings were entered as resights into WinCruz. We did not realize until later in the sighting that an actual sighting number had not been entered. The resights were connected to a deleted Tursiops sighting in the morning. Because the original sighting was so long ago, they were not displaying properly on the WinCruz map. Altogether, there were 7 surfacings recorded into WinCruz, and additional resights were shouted out by Felipe and Sergio, sometimes saying “up” simultaneously.

Felipe Triana – initial sighting narrative – I initially saw the animal at 1654 off the starboard bow at 35 degrees and 4 reticles on the big eyes. I saw a small cetacean surfacing three times slightly towards the right and away from the vessel. The animal was at an angle so I wasn't able to determine a triangular shaped dorsal, but it was a small animal maximum length of 1 meter and it wasn't a fish so I suspected it must be vaquita. After the 5th surfacing, Sergio (who was on the left big eye) saw the animal at 50 degrees and 4 reticles and confirmed it was a vaquita. It was behind a sitting bird, which helped Sergio locate it. At this point the vaquita had switched

directions towards the left. The vaquita surfaced several times in that direction, slowly getting away from us. The vaquita went down, and resurfaced after a couple minutes but I wasn't able to spot it. Sergio saw it surface at 17:07 at least three more times continuing in the direction left and away from us. A few more seconds passed before it resurfaced, this time I was able to see it again. At 12 degrees right and 5 reticles. The animal was now swimming towards the right and still away from the vessel. It surfaced several times progressively getting farther away again. The Narval was notified and approached to try to locate the animal. Once the Narval got closer, I did not see the animal again. The Narval however, did see it. At this point, I switched out with Ernesto because I had to move the tarp above, that serves as our shade, to move it out of the way. I was also hoping to be able to get a photo, but I never saw it again. At this point the Narval observers were the only ones to see the animal. The Narval observers were the last to see it. Throughout the 12 surfacings I only saw one animal.

Sergio Martinez narrative - Felipe saw the vaquita for the first time at 1654 and told me the position. I couldn't find it with the left big eyes. A few second later he had a resighting and after that at 17:07, I saw one vaquita at 5 right and reticle 5. The vaquita was going between a course of 340 and 350. It had a triangular dorsal fin, no scars visible and good body condition (not skinny). It seems that it was "small" (but there is nothing to compare to), the vaquita came up to the surface and breathed 3 times but Felipe could not find it in that surfacing. One and a half minutes later, it came up to the surface and breathed 4 times, heading almost in the same direction. Felipe and I, both saw the vaquita and we said "up" each time it came up to the surface. After that the Narval arrived on our port side and they had a resighting. After that we were trying to find it again until the sunset but, we didn't find it again.



Figure S7. Screen shot of Sighting 8.

Narval narrative:

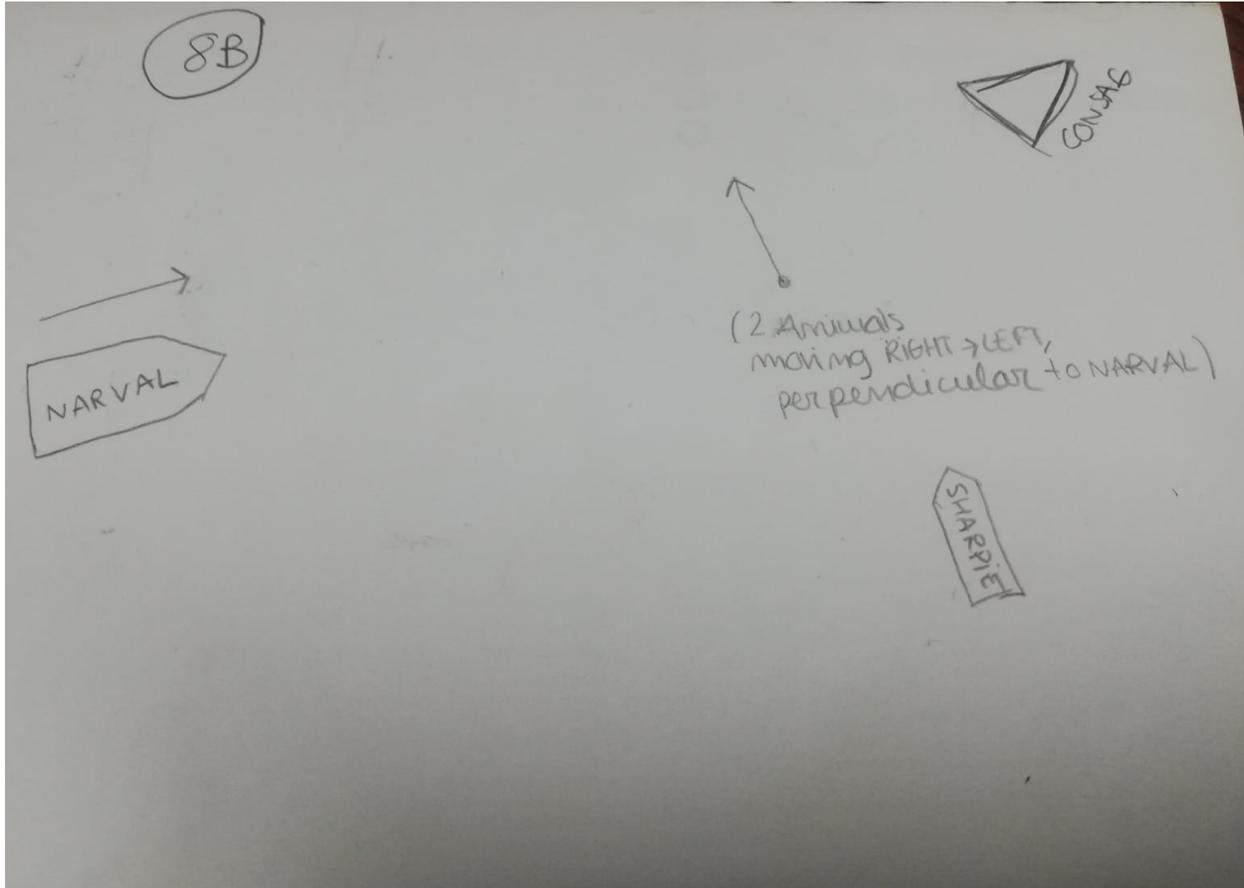
A. Jaramillo narrative from the bridge of the Narval: Sharpie observers alerted me to the sighting using Whatsapp so I could tell the flying bridge team. Moments later Juan Carlos called a resight (but his sighting was later confirmed to be a bottlenosed dolphin) and I then moved to the 20x bigeyes on the front of the bridge to help scanning for the sighting.

I then heard the cameraman Joel saying that the sighting was between our boat and Rocas Consag. I moved bigeyes in that direction and seconds later saw two animals surfacing. They rolled in the usual manner vaquitas do, with a rapid movement, not showing all the rostrum nor the flukes. The animals were, from my angle, close together as I saw a dorsal fin of the animal closer to me and half the size of the dorsal fin of the other animal. The 20x bigeyes do not have reticles, but I estimated that the animals would have been between 1.5 and 2 reticles away in the 25x binoculars.

The animals swam to the left, and were seen to the left of Rocas Consag. I kept searching on the left side of the vessel, but did see the vaquitas again.

E. Hidalgo narrative: After the sighting was reported by the Sharpie, the Narval approached the area of their sighting to help search. I was the recorder together with Annette. While standing behind the recording station with handheld binoculars (7X30) I scanned the horizon. Just in front of Rocas Consag I saw two surfacings of a vaquita (at approximately at 17:15). Initially I thought of it as the same animal surfacing twice, one body length apart between surfacings. I used the observed triangular fin and its proportion to body size consistent with vaquita traits as the main identification factor. The fin and body observed on both surfacings appeared to have the same size and shape, and I only observed one fin at a time at the surface. The direction of travel was from from right to left from the bow of the Narval, passing in front of Rocas Consag. I roughly estimated the distance between the Narval and the sighting to be 800m. My observations are not inconsistent with the possibility of having two separate animals instead of one surfacing twice,

but that was my initial thought.



Drawing 3: Eva's drawing of the sighting from the Narval's point of view.

Joel – As part of the media team, I was sitting between the two Big Eyes on the flying bridge, right in front in the middle. Because of the sighting from the Sharpie, I was looking through my camera viewfinder trying to relocate the sighting. I was using a 600mm lens + 2X teleconverter but my camera was in standby. Then I spotted them right in front of Roca Consag. I saw them once, and seeing two animals surfacing consecutively and shortly after each other very close together. I saw the two animals being almost on top of each other, which I think may have been caused by my point of view. I did not have time to obtain a picture or video, and while trying to change modes to be able to record them, I lost the sighting.

Henoch -- At the same time as Armando, I saw two vaquita surface together using camera with 400 fixed lens in the area between Rocas Consag and Narval while standing on bridge deck.

Animals were perpendicular to the camera and one animal was slightly behind the other.

Appeared to be mother-calf pair. I also saw what I considered to be a calf in sighting 3 and thought that calf appeared darker than this calf.

Video 3 available from L. Rojas-Bracho on request

Participants (legs present in parentheses, visual (v) or acoustic (a)). An asterisk indicates the participant was an ‘expert’ in the full 2-day elicitation.

Sharpie:

Sarah Mesnick (1 & 2, v)*

Ernesto Vazquez (1 & 2, v)

Sergio Martinez (1 & 2, v)*

Felipe Triana (1 & 2, v)*

Isidore Szczepaniak (1 & 2, v)*

Chris Hoefler (1, v)

Narval:

Armando Jaramillo (1 & 2, a)

Gustavo Cardenas (1, a)

Juan Carlos Salinas (1 & 2, v)*

Marc Webber (1 & 2, v)*

Barbara Taylor (1, v)*

Dawn Breese (1, v)

Jay Barlow (1, v)*

Robert Pitman (1, v)

Annette Henry (2, v)*

Eva Hidalgo (2, v)*

Allison Payne (2, v)*

Text S3: Population dynamics model

We constructed an age- and sex-structured population dynamics model. We assumed 6 age classes: calf, juveniles (aged 1-4) and adults (aged 5+). Adult females can potentially breed, and hence the female age at first reproduction was 5. (Females aged 4 can become pregnant, and assuming an approximately one-year gestation would give birth when aged 5.) Females were assumed to give birth to single calves and the inter-breeding interval was assumed to be 1.5 years (i.e., probability of an adult female giving birth per year was 0.75). Sex ratio at birth was assumed to be 50:50 and all age-specific survival rates were assumed equal between sexes. Adult survival was set so as to achieve a fixed level of expected population change (see below). Calf survival was set at 0.3 adult survival and juvenile survival at 0.95 adult survival.

The above is sufficient to construct a 12x12 population projection matrix as follows:

$$\begin{pmatrix} 0 & 0 & 0 & 0 & 0.5 \times 0.75 \times 0.95\phi_a & 0.5 \times 0.75 \times \phi_a & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.3\phi_a & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0.95\phi_a & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0.95\phi_a & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.95\phi_a & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.95\phi_a & \phi_a & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.5 \times 0.75 \times 0.95\phi_a & 0.5 \times 0.75 \times \phi_a \\ 0 & 0 & 0 & 0 & 0 & 0 & 0.3\phi_a & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.95\phi_a & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.95\phi_a & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.95\phi_a & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \phi_a & \phi_a \end{pmatrix}$$

where ϕ_a is adult survival. The stable age structure of such a model is given as the eigenvector associated with the dominant (real) eigenvalue of this matrix. In the above case, where survival in all age- and sex-classes scales according to the same value (ϕ_a), then the stable age structure does not depend on the value of ϕ_a and is the vector

(0.157, 0.042, 0.036, 0.030, 0.026, 0.209, 0.157, 0.042, 0.036, 0.030, 0.026, 0.209)'. The

population we used was stochastic, based on the above population projection matrix, as detailed below.

Ten-thousand random realizations of the population model were generated. For each realization, to generate a starting population size in 2018, a value was sampled from the posterior distribution of population size in 2018 of Jaramillo-Legorreta et al. (2019), discretized to the nearest integer. Numbers in each age- and sex-class were then derived by sampling from a multinomial distribution with probabilities equal to the stable age structure given above. To project forwards to 2019, 2020 and 2021 a value of ϕ_a is required. This was obtained by taking the 2017-2018 population change associated with the posterior sample that generated the 2018 population value and finding the value of ϕ_a that generates the same expected population change, assuming a deterministic population dynamics model with the above population projection matrix. For a deterministic population dynamics model with stable age structure, population change is given by the dominant (real) eigenvalue of the matrix. Given the obtained value of ϕ_a the population simulation then proceeded as follows. First survival was simulated for each age class assuming a binomial distribution with survival probabilities $0.3\phi_a$, $0.95\phi_a$ and ϕ_a for male and female calves, juveniles (in each age class 1-4) and adults respectively. Then all animals were aged by one year, with the age 5 category being an absorbing age class (so animals don't age beyond 5). Lastly, breeding was simulated as a binomial process independently for males and females with probability 0.5×0.75 , except for realizations with 0 adult males, where number of calves was set to zero.

The population change values for 2017-2018 sampled from Jaramillo-Legorreta et al. (2019) included a small number of positive population changes (since the upper tail of the posterior distribution on population change was greater than 1). The maximum expected population increase from the population model, which is obtained by setting ϕ_a to 1.0, is 1.06 (i.e., an

increase of 6% per year). A very small number (~1%) of sampled population changes were more positive than this, and in this case we set ϕ_a to 1.0. This will result in a small negative bias in these simulations.

For each realization, the probability that the simulated population size was greater than or equal to the elicited minimum number alive was determined as follows. For 2019, the EE distribution was expressed in the form of a beta distribution on minimum population size. This distribution was used to determine the probability the minimum population size was equal to or lower than the number of simulated vaquita in 2019. For 2021, the EE distribution was expressed in the form of a discrete probability distribution on minimum population size; we used this to determine the probability the minimum population size was equal to or lower than the number of simulated vaquita in 2021. We then multiplied the probabilities for 2019 and 2021 together.

We would have liked to include the information about elicited number of calves in this evaluation, since the age-structured simulation produced number of calves as well as total population size. However, the elicited distributions on total and calf population size were not independent, and the EE was not designed to retain information about the dependency structure, so rather than make an unjustified assumption (e.g., that quantiles on the total and calf distributions match), we elected not to use the calf distributions.

To obtain an overall estimate of probability that population size was greater than or equal to the elicited minimum, we took the average over the 10,000 realizations.