Fisheries New Zealand
Tini a Tangaroa

Final Workshop Report

Orca Capture Incident Workshop

Workshop held in Wellington, New Zealand on 16 February 2018
MPI Technical Paper No: 2018/02

By
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DISCLAIMER

The following report contains an appendix with pictures of a deceased orca that some people might find disturbing. Discretion is advised.

ISBN No: 978-1-77665-817-6 (online)
ISSN No: 2624-0246 (online)

May 2018

New Zealand Government

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1 Participants

Chair - Dr Ben Sharp, Principal Scientist, MPI

- Tiffany Bock, Team Manager Deepwater Fisheries (Acting), MPI
- Kris Ramm, Science Adviser Marine Species and Threats, DOC
- Laura Boren, Science Adviser, Marine Species and Threats, DOC
- Dr Ingrid Visser, Orca Trust (Orca expert)
- Dr Wendi Roe, Massey University (Veterinary pathologist)
- Richard Wells, Resourcewise Ltd. (Fisheries Technologist)
- Jack Fenaughty, Silvifish Resources Ltd. (Fishing expert)
- Dr Michael Moore, Woods Hole Oceanographic Institute (Marine mammal expert)

Apologies

- Dr Stephen Raverty, British Columbia (Veterinary pathologist)
- Anton van Helden, Forest & Bird (Marine mammal expert)
- Nigel Scott, Ngai Tahu

2 Context

On 6 December 2017, the Ministry for Primary Industries (MPI) was notified by an MPI Fisheries Observer of the capture of an orca (*Orcinus orca*) on that day by a deepwater trawl vessel. The orca was reported as being dead, female, 5-6 meters in length, and caught by a commercial trawl vessel on a tow targeting silver warehou (*Seriolella punctata*) about 30 nautical miles (56 km) northeast of Banks Peninsula (South Island, New Zealand). Photos were taken of the animal, and the MPI observer took a tissue sample prior to the orca being returned to the sea.

An initial review of information available immediately following the 6 December incident, including photos taken of the orca and its injuries, was inconclusive as to time and/or cause of death, and whether or not the animal was already dead at the time that it entered the trawl. MPI convened a workshop attended by experts in a range of relevant fields, to better understand this incident and inform the development of improved data collection protocols for similar rare capture events.

3 Other New Zealand orca capture incidents

Orca captures by trawl fishing vessels are not common. In all New Zealand fisheries observer records prior to this capture incident, there has been a single observed orca capture by a fisheries observer on board a commercial fishing vessel; this prior capture was by a Japanese surface longline vessel in 1990. It is not clear to MPI if that captured individual was released alive. Additionally, another orca capture by a surface longline vessel was reported by fishers (but not observed by fishery observers) in 2003; in that instance the orca was freed and released alive. There are no previous records of an orca capture from trawl fishing in New Zealand.

Other incidents involving orcas entangled in crayfish pot lines have been reported by fishers or members of the public. Entanglement incidents are summarised in a report for the Department of Conservation (Laverick et al 2017). Other interactions and/or evidence of past entanglements have also been reported to the Orca Research Trust (website link in References section).

4 Purpose

The purpose of the MPI Orca Capture Incident Workshop was to:

- Provide expert advice to MPI and the Department of Conservation (DOC) regarding the likely time and cause of death of the orca captured in the fishing event on December 6, 2017
- Provide recommendations to MPI to support the development of MPI's data collection and reporting protocols for rare protected species capture events.

5 Workshop Process

Prior to the workshop, an agenda and terms of reference were agreed by workshop participants, and high-resolution digital photographs of the captured orca were distributed in order to allow workshop participants to familiarize themselves with the orca's injuries before the workshop commenced. On the day of the workshop the sequence of the workshop agenda was modified slightly to optimise remote participation by Dr Michael Moore, who was calling from overseas.

The workshop considered the following evidence, with considerable discussion between expert participants[1] regarding what conclusions could be drawn from each:

- At-sea communications transmitted to MPI from the vessel and the fisheries observer
- Fisheries observer debrief notes
- Diagrams and photographs of the underside of the fishing vessel[2], and of the trawl gear (Figure 1)
- Photographs of the orca and its external injuries (Appendix 1)
- Vessel tracking data of all vessels with GPS transponders in the area of the capture in the time period preceding the incident
- Photographs and summarised physical characteristics of vessels in the area

Following the review of these materials, the workshop sought first to 'eliminate the impossible', i.e. to rule out hypotheses that are incompatible with available data. Next the workshop sought to construct plausible hypotheses that might account for all available data, and to suggest which of these were most likely, noting remaining uncertainty.

Last the workshop briefly discussed recommendations to improve data collection protocols for fisheries observers in the event of similar rarely observed capture events in future. Experts agreed to provide more detailed recommendations in writing following the workshop.

Subsequent to the workshop, a draft workshop report was distributed to all attendees, and also to Dr Stephen Raverty and Anton Van Helden (who had accepted the terms of reference to participate but were unavailable on the day of the workshop itself). Written feedback and editorial suggestions were received from all non-government attendees, including Dr Stephen Raverty. These were addressed and incorporated by MPI into this final workshop report. No clearly dissenting views were registered regarding the workshop's conclusions; editorial decisions regarding inclusion of supporting material and the level of detail to be included in this report were made by MPI.

[1] Note do to unforeseen travel schedule interruptions Dr Ingrid Visser arrived subsequent to some of these discussions; these were summarised for Dr Visser on her arrival and revisited as necessary to solicit Dr Visser's unique expertise and to enable Dr Visser to ask questions of other experts present. Similarly Dr Michael Moore did not participate in the final 2 hours of workshop discussions, but reviewed the outcomes of these discussions in the draft report.

[2] This information was shared in the context of the workshop but does not belong to MPI

6 Review of available information:

The workshop noted the following important points with respect to the data considered.

6.1.1 Vessel and observer communications, and observer debrief

- That the vessel first officer reported that the orca 'smelled' suggests a time of death > 6 hours prior to retrieval of the body.
- Had the fishing vessel struck the orca with its propeller, it is likely this would have been felt on board the vessel and noted by vessel crew and the observer.
- That the orca only became visible as fish were removed from the front of the net, and that the orca's tail became visible first, suggests that the orca entered the trawl net head-first.
- That the orca was retrieved in the 'middle' of the bag with fish all around suggests the orca was not captured at the very beginning or very end of the tow, but no more precise conclusion can be inferred regarding timing of the orca entering the fishing net.
- No conclusions can be drawn from the absence of other orca observed around the vessel; orcas can acoustically communicate over longer distances than an observer can see, so could still effectively be part of a pod even if observed in isolation. Furthermore, observers and crew generally are not actively looking for marine mammals during fishing activity and animals may not be obvious.

6.1.2 Fishing gear configuration and vessel specifications

- The fishing vessel propeller is 4.5 m in diameter. It has four blades and during operation rotates at a constant speed of approximately 5.2 revolutions per second.
- The speed of the vessel and/or fishing gear throughout the fishing event ranged 3.5 – 4 knots (6.5-7.4 km/h); at this speed there is no component of the fishing gear that is sharp enough to produce the observable 'deep' injuries evident in the photographs.
- It is likely a dead orca in the direct path of the trawl net would be 'scooped up' into the net.
- It is less likely, but still possible, that a dead orca encountered within the wider path of the sweeps and bridles which are attached at the forefront of the net, could be deflected a short distance and laterally 'herded' into the net.
- The ocean floor in this location is mostly silty or sandy without much rough ground. At this speed it is unlikely that contact of the orca with the ocean floor prior to entering the net could account for the observable 'deep' injuries.
- There are no metal components or sharp objects capable of inflicting significant injury to the body once it was inside the trawl net.
- Because the body would be buoyed by water and was surrounded by fish, pressure or shear forces on the body would be minimal inside the net until the net was hauled out of the water, at which point the body would be immobilised by fish and the surrounding mesh webbing of the codend.
- Protected inside the net, the body would likely not sustain significant injuries of the type observed in the photographs from contact with the deck of the vessel during gear retrieval.

6.1.3 Review of photographs depicting orca body and injuries

It is possible from photographs to determine that the orca belonged to the New Zealand coastal orca population (see Visser 2000). These orcas are known to prey on demersal fish, primarily skates and rays, and are known to forage at depths comparable to or exceeding the depth in the location at which the capture occurred (approximately 200m).

A diagram of the orca's injuries is shown in Figure 2, and summarised in Table 1. Photographs are included in Appendix 1. The workshop noted the following:

- No conclusion can be drawn from the presence of fresh blood near the orca's mouth, as it is common for even older injuries to bleed anew when a body is moved (and noting that the orca's body was suspended vertically by the tail during its retrieval from the net and prior to the photographs being taken).
- The condition of the orca's skin and the grey colour of the exposed blubber and subdermal tissue suggest that the orca was not 'freshly' dead (i.e. it was dead for more than a few hours); the grey colour of the blubber is likely a consequence of oxidation/early decomposition and/or contact with fine sediments on the ocean floor.
- The lack of evidence of scavenging or advanced decomposition suggest that the orca was not dead for a 'long' time (i.e. it was not dead for several days).
- The potential presence of mobile scavengers (e.g. hagfish, sharks, amphipods, crustaceans) in the net was not recorded.
- Other fish are visible in the photographs (e.g. dogfish, carpet shark, hoki, flathead, rattails) some of which are embedded in the orca's deep trauma lesions. These are not scavenger fish and are considered 'normal' bycatch for a trawl in this depth and location; they appear to have been forced into the lesions by the pressure of the fish against the orca's body as the net was hauled. On this basis, experts judged that the photographs do not suggest active predation or scavenging of the dead orca by these fish.
- It is not possible to say how quickly the animal would have died from its injuries. Workshop experts estimated that death could have been immediate, or the animal could have survived a 'short time' (e.g. 0-3 hours) after sustaining injury.
- The injured orca would by necessity have remained at the surface until it died.
- Immediately upon its death the orca's body would probably be negatively buoyant, but it is not possible to determine how fast it might be expected to sink.
- Given the relative freshness of the carcass, it is unlikely that putrefaction gases could have accumulated to sufficient levels to cause the carcass to refloat.
- It is not possible from photographs to determine which injuries occurred pre- vs. post-mortem.
- Experts agreed that the shape of the orca in profile and when hanging vertically did not appear 'normal'. There was an initial suggestion that the body perhaps looked emaciated, but subsequently relevant experts noted that no ribs were showing and agreed that the thickness of the exposed blubber appeared normal (i.e. healthy). On this basis the workshop agreed that the abnormal body shape was most likely indicative of a blunt force trauma injury rather than poor body condition.
- Supporting the suggestion of blunt force trauma or crushing injury, the workshop noted the large (up to 1 m radius) hollow/concave area on the right general thorax, posterior to the skull and scapula and anterior to the saddle patch, and high enough that the orca's profile appears concave between the head and dorsal fin.

The workshop agreed the following:

- Experts estimated a time of death 6-48 hours prior to body retrieval.
- The injuries are not consistent with having been caused by natural predators or scavengers.
- The injuries are not consistent with a capture followed by a deliberate attempt to sink the carcass by opening up the body cavity.
- The injuries are too numerous and varied to be caused by only one 'kind' of interaction: different injuries originated from different types of contact.

Table 1. Description and possible cause(s) of injuries diagrammed in Figure 2.

Injury description	Possible cause(s)	Photo number(s)
1. Left-side longitudinal linear laceration from mouth to abdomen	Large vessel propeller at low(er) RPM	P2 – P3
2. Right-side shallow abrasions on and extending downward from dorsal fin	Trawl gear bridles / sweeps?	P8 – P10, P16
3. Deep triangular forward-facing laceration through the blubber and exposing the muscle of the right-side flank below dorsal fin	Collision with large rudder fin? (after body ejected from propeller)	P8 – P10, P16
4. Shallow abrasions on lower right side/ belly	Trawl gear bridles / sweeps?	P8 – P10, P13
5. Deep laceration across abdomen, bisecting genital slit (extension of injury #1)	Large vessel propeller at low(er) RPM	P8 – P12
6. Shallow longitudinal laceration involving skin and blubber on right side flank	Sliding along/ under large vessel, in contact with barnacles or other protrusions (???)	P8 – P10
7. Shallow longitudinal laceration involving skin and blubber on ventral surface, originating under left pectoral fluke	Sliding along/ under large vessel, in contact with barnacles or other protrusions (???)	P13
8. Concave depressions/ concertina ripples on right side, and collapsed profile between head and dorsal fin (likely broken ribs/spine?)	Impacted by large vessel moving at speed (> 10 knots)	P7, P10, P14

Injury-specific remarks are summarised as follows:

- Injuries #1 and #5 were most likely caused by a very large propeller, with wide diameter (e.g. 6+ m) and a (relatively) slow rotation speed, such as from a container vessel or large cruise ship. In forming this position, workshop attendees examined photographs of the propeller size and configuration on container ships comparable to those known to have been in the area in the period preceding the capture (see Figure 4).
- Injuries #1 and #5 are not consistent with interaction with the fishing vessel's propeller, because the smaller radius and faster rotation speed of this propeller would be expected to leave multiple lateral lacerations, not a single continuous longitudinal injury.
- Injuries #2 and #4 may have been caused by post-mortem interaction with metal components of the trawl gear (e.g. bridles) on the ocean floor.
- Injury #3 is suggestive of a high-speed impact against a sharp object from a forward angle. This could have been caused by collision with a large rudder fin after the body passed through a propeller (e.g. Figure 4).

- Injuries #6 and #7 may have been caused by the body of the orca sliding along or under a large vessel moving at high speed, but the mechanisms for how these injuries may have occurred remain unclear.
- Injury #8 is consistent with blunt force trauma, most likely from collision with a large vessel travelling at greater than 10 knots.

While each of these inferences in isolation remain somewhat speculative, the workshop agreed that, taken together:

→ The most plausible cause of the blunt force trauma and the deeper injuries is likely to be from collision with a large ship moving at high speed (> 10 knots) followed by interaction with the ship's propeller. On this basis it appears likely that the orca was struck initially by a vessel other than the fishing vessel, and that the orca was already dead when its body first encountered the fishing gear.

6.1.4 Other vessels in the vicinity of the capture event

The workshop examined data depicting the track of the fishing vessel during the tow on which the orca was captured, relative to other vessels traversing the area in the 72 hours preceding the capture event. The workshop noted the following:

- Ocean currents in this location flow either toward the northwest (at the surface) or more slowly toward the northeast (at the ocean floor). Winds were low speed (< 10 knots) from the south.
- Because it is impossible to determine how long the orca may have remained on the surface, a fatal interaction with an earlier vessel could have occurred at any location south of the path of the subsequent fishing tow on which the orca was captured
- The steaming track of the fishing vessel prior to the fishing event on which the orca was captured did not intersect or pass up-current of the capture location
- In the days preceding the capture, the area around the capture location was crossed by a number of very large (150+ m) vessels, e.g. oil tankers and container vessels.
- There is a very busy shipping lane to the north and west of the capture location, but interaction with these vessels can probably be ruled out based on ocean currents
- The workshop agreed that the orca was most likely struck by a vessel traveling at greater than 10 knots. Substantial evidence from existing studies suggests that the risk of fatal vessel strike increases sharply at speeds greater than 10 knots. Subsequent to the workshop this empirical relationship was provided from a peer-reviewed publication (Vanderlaan & Taggart 2007; see Figure 3).
- On this basis six vessel tracks were identified that fit the profile of a vessel that could have been responsible for the orca's injuries.
    - One vessel track bisected the tow path of the trawl on which the orca was recovered; five additional vessel tracks were 2-10 nautical miles away in an up-current direction (i.e. south).
    - Vessel lengths ranged approximately 170 – 260 m;
    - Vessel speeds ranged 11.4 – 21.5 knots;
    - The timing of the vessels' passing ranged 10 – 50 hours prior to the retrieval of the orca's body

7 Hypothesis testing

When all of the available evidence is considered, the hypothesis that best accounts for all available evidence is as follows:

The orca was struck by a large vessel (i.e. comparable in size and speed to an oil tanker or a large container vessel), inflicting sufficient blunt force trauma to kill or incapacitate the orca. Some shallow lacerations may have been inflicted as the orca's body slid along the side or bottom of the vessel; toward the rear of the vessel the intake from the propeller would have been sufficient to draw the orca's body into the propeller, accounting for the deep longitudinal laceration that also sliced transversely across the orca's abdomen. Additional injury may have arisen from subsequent collision with the ship's rudder after passing through the propeller zone.

After an indeterminate time on the surface, the orca's body most likely sank to the ocean floor, where it was subsequently retrieved in the fishing gear. The workshop considered that some of the shallow abrasions to the orca's right side may have occurred post-mortem in interaction with the fishing gear.

8 Observed Capture data collection protocols

Due to time constraints and interrupted availability of some expert attendees during the workshop, there was only a brief discussion of ways to improve data collection protocols for rarely observed capture events such as this one. Experts agreed that the ideal response in such an event is for the vessel/observer to establish direct contact with MPI and, if possible, to subsequently engage in direct communication with a relevant subject matter expert.

Experts also agreed that it is generally ideal if the bodies of rarely observed captures are retained whole.

Noting that operational and logistical constraints may often prevent retention of the whole specimen, the workshop agreed that new protocols could include a prepared checklist of observation, data collection, and sample collection tasks in priority order, to be completed by the fisheries observer to the extent possible. Workshop experts agreed to work together after the close of the workshop to develop recommendations regarding:

- instructions and a standard prioritised list of photographs to be taken in rarely observed capture events;
- instructions to guide expanded tissue sampling for rarely observed capture events;
- Instructions and a standard prioritised list of other observations to be recorded in rarely observed capture events.

Consistent with this commitment, relevant information has been received from Dr Roe and Dr Visser, attached in Appendix 2. This material is being considered by MPI scientists and managers in consultation with the MPI fisheries observer program, to inform the development of updated fisheries observer protocols.

9 References

Laverick S, Douglas L, Childerhouse S & Burns D (2017) Entanglement of cetaceans in pot/trap lines and set nets and a review of potential mitigation methods. *Unpublished report by Blue Planet Marine, prepared for New Zealand Department of Conservation*, 75 pp.

Vanderlaan ASM, & Taggart CT (2007) Vessel collisions with whales: the probability of lethal injury based on vessel speed. *Marine mammal science,* 23(1): 144-156.

Visser I (2000). Orca *(Orcinus orca*) in New Zealand waters. Ph.D. Dissertation. University of Auckland, Auckland, New Zealand. April 2000.

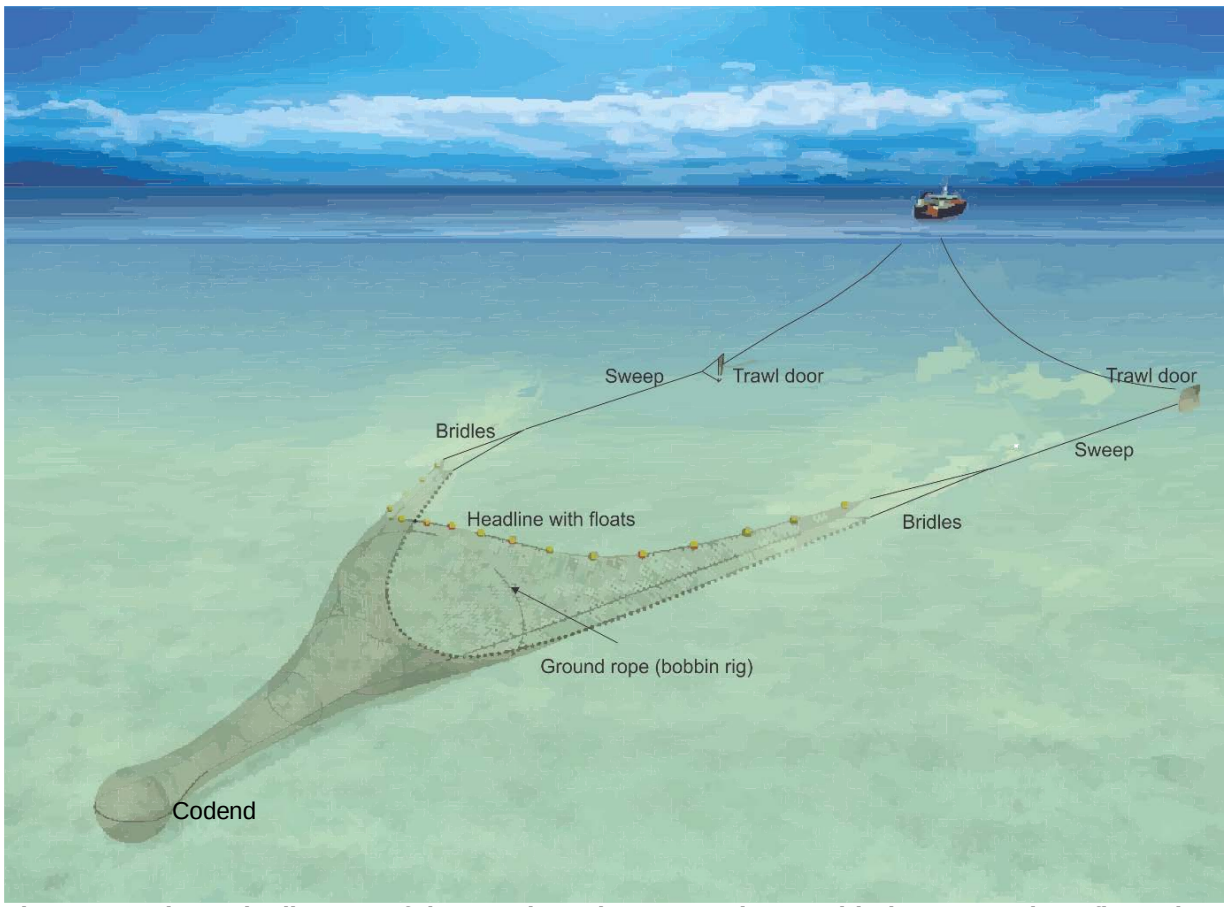

Figure 1: Schematic diagram of demersal trawl gear consistent with the type and configuration of fishing gear deployed in the orca capture incident, with individual gear components identified.

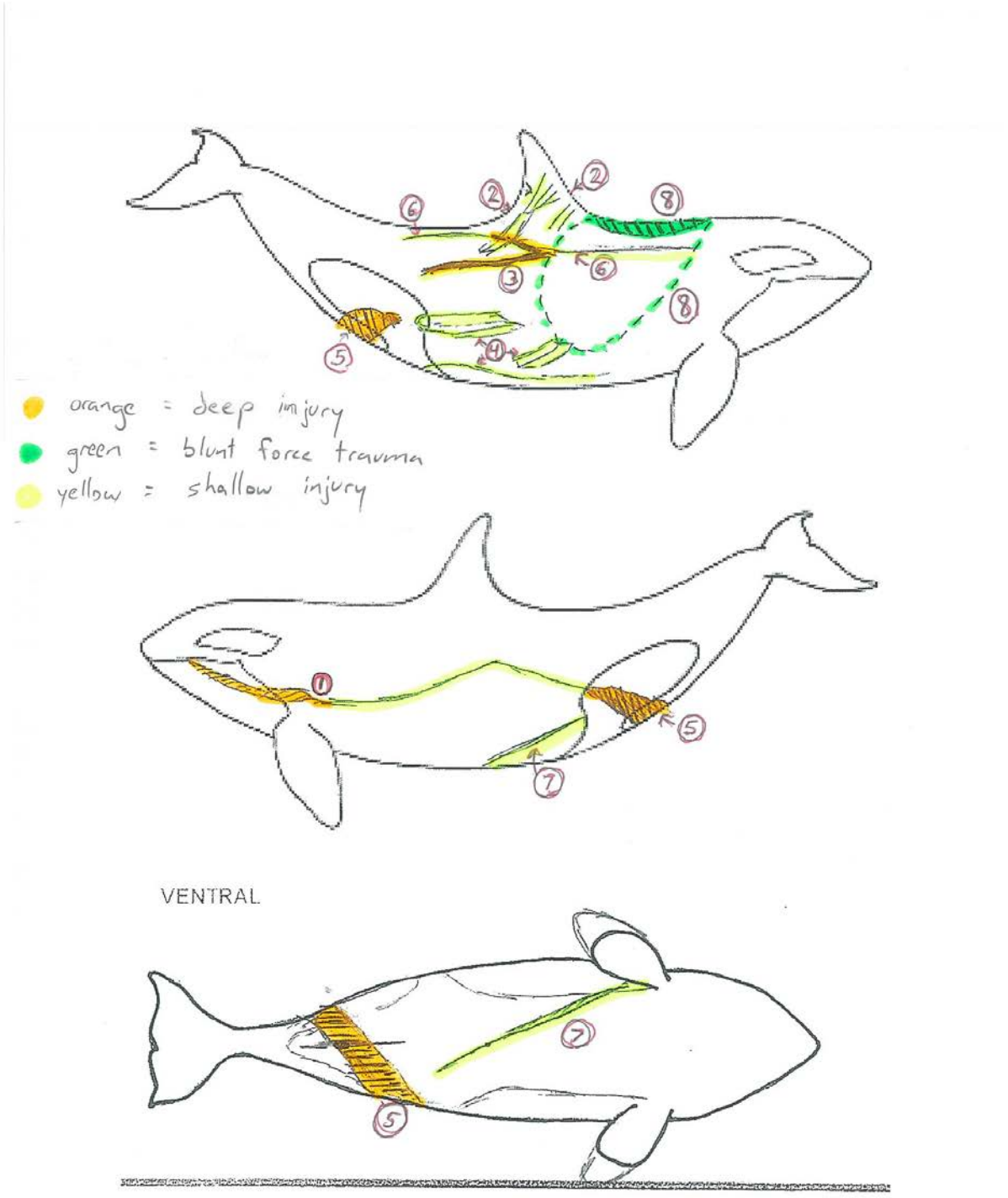

Figure 2: Diagram of orca injuries summarised in Table 1, from photographs in Appendix 1.

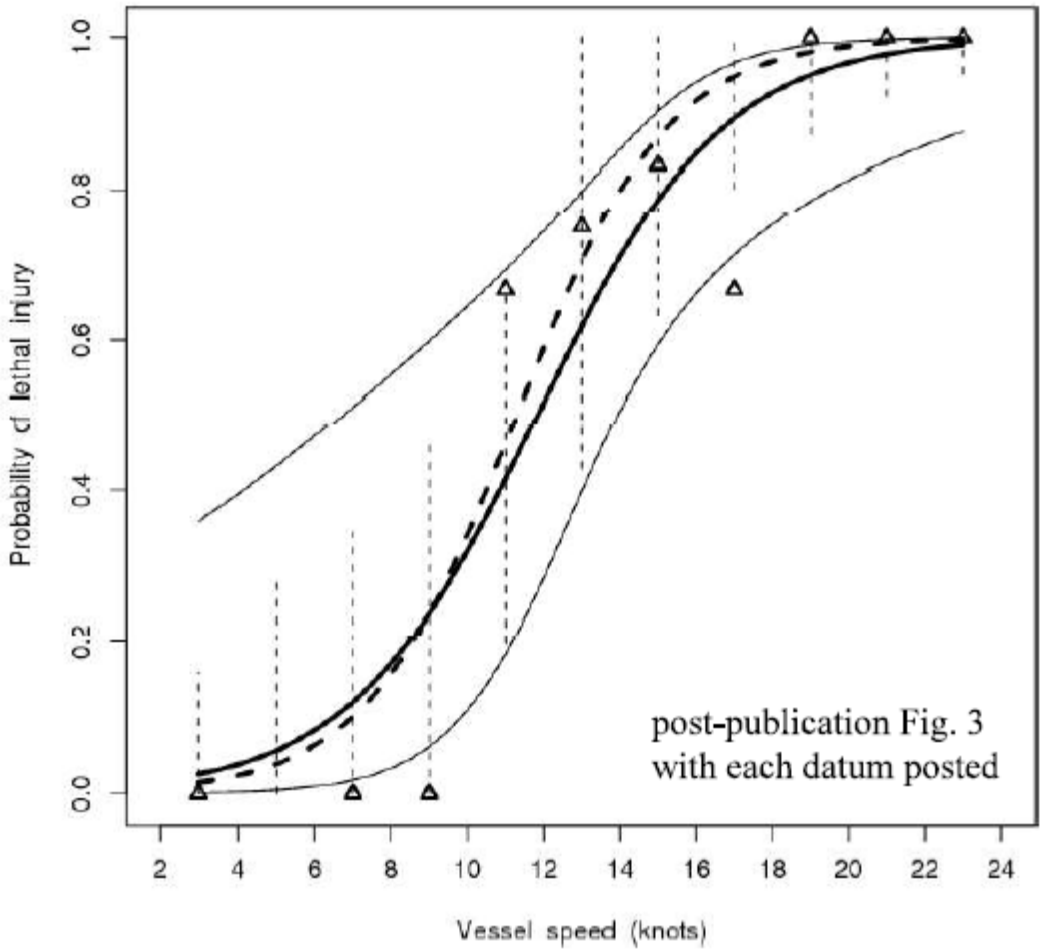

Figure 3. Probability of a lethal injury resulting from a vessel strike to a large whale as a function of vessel speed based on the simple logistic regression (solid heavy line) and 95% CI (solid thin lines) and the logistic fitted to the bootstrapped predicted probability distributions (heavy dashed line) and 95% CI for each distribution (vertical dashed line) where each datum (Δ) is the proportion of whales killed or severely injured (*i.e.*, lethal injury) when struck by a vessel navigating within a given two-knot speed class. There are no data in the 4–6 knot speed class.

Figure 3: Probability that a vessel strike with a whale will result in fatality, as a function of vessel speed (Vanderlaan & Taggart 2007).

Figure 4: Example photograph showing propeller/ rudder size and configuration for a shipping container vessel of comparable size (292 m) and build to other vessels known to have traversed the location of the orca capture 10-50 hours prior to the capture event. (Note that this is not one of the actual vessels known to have traversed the area, because drydock photos of these particular vessels were not available.)

10 Appendix 1

Incident photographs

DISCLAIMER

The following appendix contains pictures of a deceased orca that some people might find disturbing. Discretion is advised.


P1
Released by the Ministry for Primary Industries
2017/12/06


P2
Released by the Ministry for Primary Industries
2017/12/06


P3
Released by the Ministry for Primary Industries
2017/12/06


P4
Released by the Ministry for Primary Industries


P5
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P6


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P7


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P8


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P14
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P15
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P16
Released by the Ministry for Primary Industries

11 Appendix 2

Supplemental material to inform improved data and sample collection protocols

Material submitted by Dr Ingrid Visser

PHOTOGRAPHS – alive or dead

All photos taken at 90 degree angle to animal (to preserve perspective)

1. The whole animal, both sides.
2. The whole animal, dorsal & ventral
3. The whole animal from head looking along body (so at eye height, to show distortion of body such as broken spine)
4. The dorsal fin, both sides (please fill the frame and ideal if you can place a white or grey cloth or plain coloured board behind fin)
5. The saddle patch, both sides (please include the beginning of the 'forward sweep' and the pattern along the start of the spine)
6. Eye patches, both sides (please fill the frame).
7. The mouth line, including the gape (corner of the mouth), both sides.
8. #Scars & wounds *e.g.,* on dorsal and pectoral fins, and tail flukes (please note the total number of cookie cutters shark bites wounds and scars visible on each side, dorsal and ventral)
9. Anomalous pigmentation (e.g*.,* a black dot on the eye patch)

Please photograph all of these with a measure in the frame if possible

ORCA SAMPLE COLLECTION LIST (MPI OBSERVERS)

- Please ensure all samples are labelled with the date in **yyyymmdd** format
- Add collectors name (or identification code), so samples can be tracked back to event.

Labels are to be written in pencil, on waterproof paper and placed between an inner and outer ziplock bag. This is to prevent the label and/or text from dissolving, if either the contents leaks or condensation forms during storage.

SAMPLES (MINIMUM):

Skin with blubber attached.

- **Three** 5x5 cm block
- **One** with grey skin, taken from the 'saddle patch' (posterior to the dorsal fin)
- **One** with black skin
- **One** with white skin

Muscle.

- **Three** 5x5 cm block
- Can be extracted from below the skin & blubber samples)

'V'-shaped piece of tissue.

- Three of the widest part of V approximately 5 cm
- Cut from trailing edge of tail fluke (or if flukes unavailable, from flipper or dorsal fin - however, see 'dorsal fin' below)
- Cut to include upper and lower surfaces and all connective tissue.

"Others"

- If there are sucker-fish, barnacles etc. attached to or associated with the specimen, please collect these and keep frozen

STORAGE

(each sample type is stored three different ways)

- **One of each** sample type, immersed in DMSO/saline solution (in leak proof containers – see 'kit' details). Placed in plastic ziplock bag, then bagged again. Label between the two plastic bags. **Chilled.**
- **One of each** sample type, aluminium foil-wrapped. Placed in plastic ziplock bag, then bagged again. Label between the two plastic bags. **Frozen.**
- **One of each** of each sample type, placed in plastic ziplock bag. Placed in plastic ziplock bag, then bagged again. Label between the two plastic bags. **Frozen**.

SAMPLES (ADDITIONAL) (*in no particular order*)

Dorsal fin (intact)

- Cut off as far down at the base as possible (preferably into the back of the animal). Stored in plastic (double rubbish bags work well). **Frozen intact**.

Whole lower jaw with all teeth *in situ*

- Lower jaw can typically be disarticulated easier when the carcass is on its side or back.
- Once disarticulated, to protect teeth, wrap in towel, clean rags or heavy layers of paper towels (or similar). Double bag (rubbish bags are ideal). **Frozen intact**.

Teeth 3-5 (see above regarding whole jaw)

- Taken from the mandible (lower jaw) midway along the jaw. Individual teeth wrapped in damp paper towel. All placed together in plastic ziplock bag.
- Label to include LEFT or RIGHT mandible, and how many teeth taken. Note first tooth removed (tooth position), by counting teeth from front of jaw. **Chilled**. (Frozen if chiller not available).

Whole head.

- Intact (can leave lower jaw attached & teeth *in situ*, see above). Double bag (rubbish bags are ideal), label between bags. Frozen. Double bag (rubbish bags are ideal). **Frozen intact**.

Tissue from major organs (e.g., lung, liver, kidney, heart)

- **Three** 5x5 cm blocks of any that can be collected. Individually labelled with organ (if unknown, please label as such) and stored as above.

Ovaries / testes. (LEFT and RIGHT where possible).

- Bagged separately and labelled as LEFT or RIGHT. Placed in plastic ziplock bag with date and collectors name and then bagged again. **Frozen intact**.

Bones.

- Any bones which can be extracted (or part of bones, if broken or exposed and can be removed). Double bag (rubbish bags are ideal). **Frozen intact**.

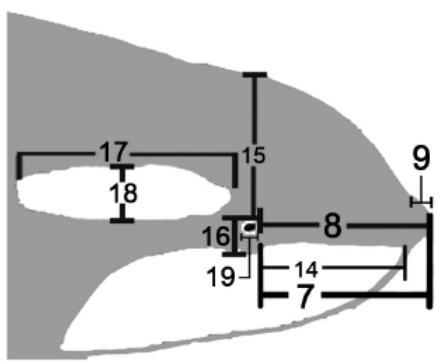
Stomach & intestine.

- Can be zip-tied (or tied off with string) at oral and anal ends to prevent leakage). Triple bagged. **Frozen intact**.

OBSERVER'S 'TAKE-ABOARD' KIT FOR NECROPSY

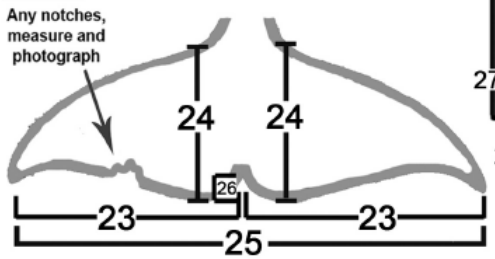
- Rubber gloves
- Scalpel with blades / or sharp bladed knife
- DMSO/saline solution (in liquid proof containers)
- 60ml plastic leak-proof wide-mouthed bottles
- Waterproof labels & pencil
- Ziplock bags and rubbish bags (if not already available aboard ship)
- Aluminium foil
- Zip-ties

#	⌀ = zero, I = one, ⅞ = seven	all measurements in [cm]		📷 ✓
1	Total body length			☐
2	Rostrum to front of anus			☐
3	Rostrum to front of genital slit			☐
4	Rostrum to tip of dorsal fin			☐
5	Rostrum to front pectoral insert			☐
6	Rostrum to blowhole			☐
7	Rostrum to mouth gape	L	R	L ☐ R ☐
8	Rostrum to eye	L	R	L ☐ R ☐
9	Rostrum length			☐
10	Blowhole to front of dorsal fin			☐
11	Width dorsal fin, widest at base			☐
12	Height dorsal fin			☐
13	Thickness dorsal fin			☐
14	Lower jaw to mouth gape	L	R	L ☐ R ☐
15	Eye to dorsal surface of head	L	R	L ☐ R ☐
16	Eye, (ventral edge) to mouth gape	L	R	L ☐ R ☐
17	Eye patch length	L	R	L ☐ R ☐
18	Eye patch height	L	R	L ☐ R ☐
19	Eye length	L	R	L ☐ R ☐
20	Pectoral fin width, at insert	L	R	L ☐ R ☐
21	Pectoral fin width, widest	L	R	L ☐ R ☐
22	Pectoral fin length, longest	L	R	L ☐ R ☐
23	Fluke length, from notch to tip	L	R	L ☐ R ☐
24	Fluke width each, widest	L	R	L ☐ R ☐
25	Total tail width, i.e., both flukes			☐
26	Depth of notch in tail flukes			☐
27	Naval to front of genital slit			☐
28	Length of genital slit			☐
29	Anterior of genital slit to anus			☐
30	Girth at tail stock			☐
31	Girth at anus			☐
32	Girth at genital slit			☐
33	Girth at navel			☐
34	Girth at widest, behind dorsal fin			☐
35	Girth at widest, in front of dorsal fin			☐
36	Girth at pectoral fin insert			☐
37	Girth in front of pectoral fin			☐
38	Tooth count upper jaw	L	R	L ☐ R ☐
39	Tooth count lower jaw	L	R	L ☐ R ☐
40	Blubber thickness dorsal 📷 ☐	Cookie cutter bite marks & 📷 of each (with scale)		# 📷 ☐
41	Blubber thickness ventral 📷 ☐			

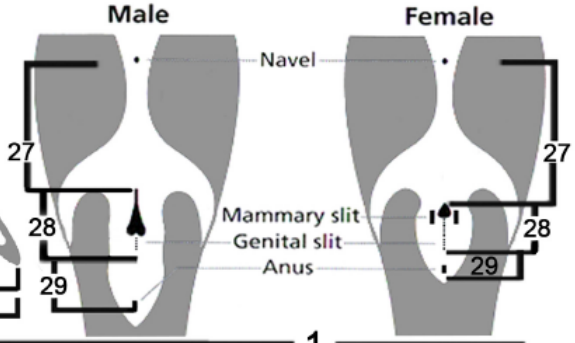


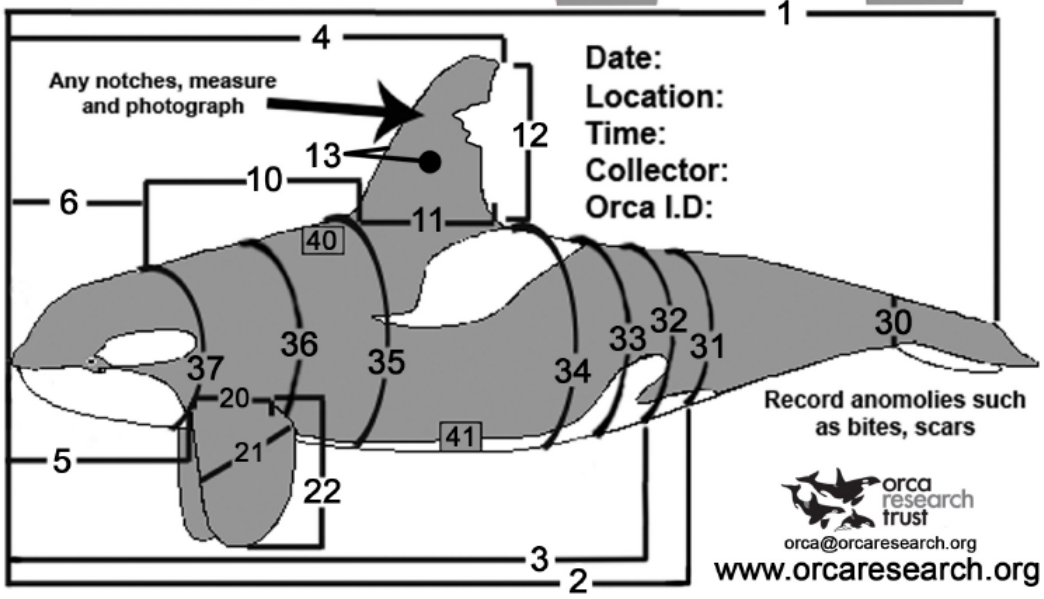
NOTE: PHOTOGRAPH (& use SCALE)
underside of flukes ☐, saddle patch L ☐ R ☐,
and any notches on fins & flukes
++ tick boxes for each image taken (see list) ++

NOTE: measure WEIGHT if possible & collect SAMPLES



☐ < tick box > ☐





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