3rd Meeting of the Stock and Ecological Risks Assessment (SERAWG3)
08-11 March 2021
(online)

Killer whale photo-identification made easy

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Relates to agenda item: 4. Patagonian Toothfish   Working paper ☐ Info paper ☒

Delegation of French Territory

Abstract

Photo-identification, a technique that uses photographs to identify individuals in animal populations through natural markings visible on their body is central for research on cetaceans and their interactions with fisheries. When applied to killer whales (*Orcinus orca*) involved in depredation-interactions, the technique has proved extremely useful to understand the impacts of these interactions on fishing activities, fish stocks and whale populations. This paper provides a simplified yet comprehensive protocol for implementing consistent photo-identification effort by observer or crews from fishing vessels experiencing depredation in the SIOFA area with limited costs and limited interference with existing workload. The key steps of this protocol include:

- Setting gear in speed priority and high shutter speed (minimum 1/1000s)
- Taking pictures of the dorsal fin, the saddle patch and the eye patch of killer whales when individuals come to the surface;
- Taking as many pictures as possible (storage should not be a limit, tips for easy storage provided).

While the use of DSLR cameras with 400mm lenses is advised, the paper shows that bridge cameras can be also used for photo-identification purposes as a cheaper and easier-to-handle alternative type of gear.

1   INTRODUCTION.

Photo-identification is a technique that uses photographs of animals to identify individuals through natural markings visible on their body (Bigg, 1982; Whitehead, 2001). This technique has proved to be extremely useful for research on cetaceans, generating major findings on the biology, ecology, behaviour, abundance and movements of individuals and populations over the last 40 years (Hammond et al. 1990). More importantly, long-term photo-identification data collected from fishing vessels have allowed for critical advances in our understanding of whale-fisheries interactions, the impacts of these interactions on fisheries and whale populations and the development of mitigation solutions (Guinet et al. 2015; Tixier et al. 2015, 2017).

For instance, photo-identification has been implemented by fishery observers on board French fishing vessels targeting Patagonian toothfish (*Dissostichus eleginoides*) for nearly two decades. In this fishery, observers have been all provided with SLR cameras and 100-400 mm lenses and take photographs of killer whales and sperm whales during interactions events with longlines on a routine basis following protocols previously presented at CCAMLR (Gasco et al 2013). These protocols were developed in a way that they minimize extra workload for observers. This effort has generated extensive monitoring datasets of whale populations at Crozet and Kerguelen (Tixier et al. 2021), and this monitoring has allowed for key questions to be addressed such as:
- How many whales interact with fishing vessels?
- Is depredation a behaviour spreading within whale populations?
- What are the effects of depredation interactions (with both licensed and IUU vessels) and of the fish taken as human-induced food subsidies on the demographic parameters of killer whales populations?
- How do these effects alter fish stocks and local ecosystems?
- How do the whales move and follow vessels across fishing areas?
- From what distance can the whales detect vessels?

However, in a number of other fisheries, such photo-identification has either been sporadically implemented or not implemented at all. In fact, in most other toothfish fisheries, photo-identification is not routinely conducted and observers use personal equipment to opportunistically collect pictures. Unfortunately, poor photo-identification effort paired with low quality photographs may greatly limit our understanding of the impacts of whale depredation on fishing activities, fish stocks and whale populations, as well as the research on mitigation of the issue. From feedbacks, reasons as for why photo-identification programs were not consistently implemented from fishing vessels included concerns about additional workload for observers and the fact that SLR cameras and 100-400 mm lenses are expensive and may be difficult to use by observers given their size and the complexity of the settings. Therefore, by capitalizing on the experience gained from fisheries where photo-identification protocols have been successfully in place for years, this paper present summarized guidelines

and provide simple tips to easily implement this technique aboard as many vessels as possible. In addition to guidelines designed to optimize photo-identification effort limiting additional workload but ensuring high quality data, the paper also explores the use of multiple types of photographic gear of varying cost and complexity.

Here we present what should be aimed when taking pictures and then a case study with comments on pictures taken during consecutive haulings and the feedback we would provide to him on his work.

2   WHAT TO AIM?

Effort should be concentrated on:

-   Photographs of the side of individuals (both right and left sides) showing the dorsal fin, the saddle patch and/or the eye patch should be taken when the animal comes to the surface. These 3 body parts bear natural markings (general shape, presence of scars, nicks, notches, etc.) showing variation across individuals, and are the features being primarily used to identify and monitor killer whales (Figure 1)
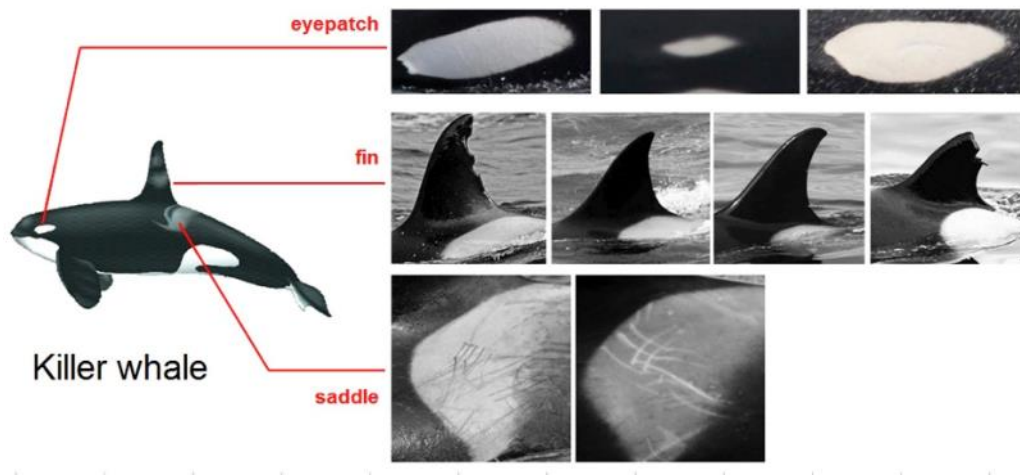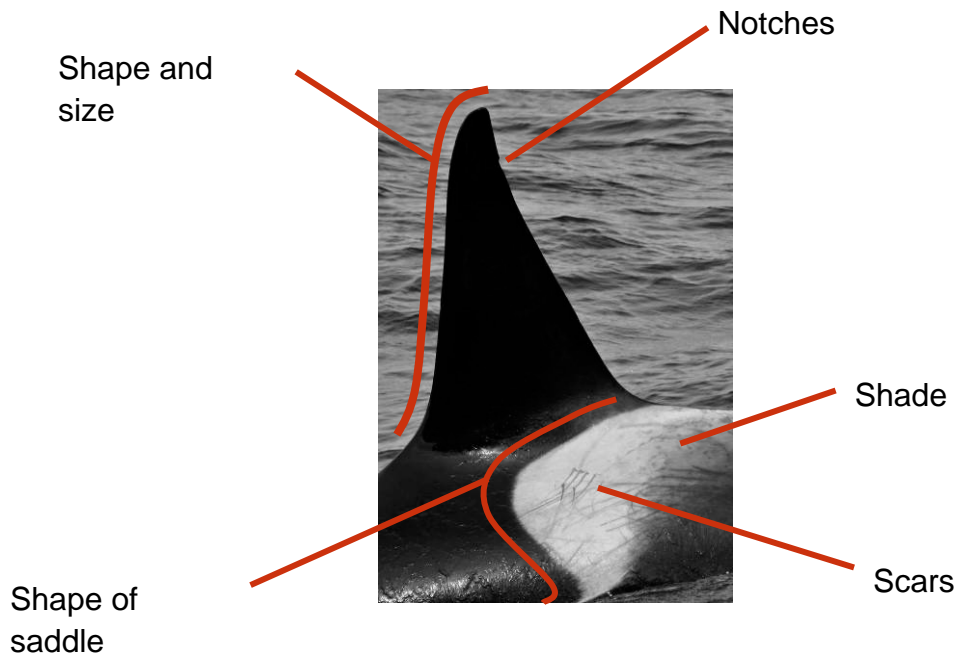
Figure 1 Different part of the body that provide information used to identify killer whale individuals.

3   CASE STUDY

3.1   LONGLINE 1 (SPEED ISSUE)

Figure 2. Photos taken when hauling longline 1.

Observer's comment :	30 minutes to get those pictures that are not focused, very disappointed…

Feedback to observer:

Quality	Not great unfortunately, speed was not set to 1/1000 s	🙁
Informations on individuals	Not much we can do	🙁
Conclusion	Must check gear is on speed priority mode and set speed to 1/1000s,continue	🙁

Pictures with a 1/1000s speed setting would have looked like this :

Figure 3. Photos not taken when hauling longline 1 but that would have been taken with higher speed setting.

3.2 LONGLINE 2 (ANGLE ISSUE)

Figure 4. Photo taken when hauling longline 2

Observer's comment :	2 hours on the upperdeck waiting for the best moment to capture this exceptional picture !! this time speed is 1/1000s

Feedback to observer:

Quality	Nice light, focus is good, very esthetic!!	😊
Informations on individuals	The eyepatch might be used to identify this individual but can't see the saddle, fin's angle is not very easy, no idea of who are the other individuals around	😟
Conclusion	It is better than nothing but it's a lot of time spent harvesting not much information…	😐

3.3 LONGLINE 3 (DISTANCE ISSUE)

longline 3 (1)

longline 3 (2)

longline 3 (3)

longline 3 (4)

longline 3 (5)

Figure 5. Photo taken when hauling longline 3

Observer's comment :	5 minutes to take those 5 pictures and then 2 hours spent waiting for them to come closer but it never happened !

Feedback to observer:

Quality	Focused and sharp	🙂
Informations on individuals	very likely to allow identification despite distance	🙂
Conclusion	Some groups never come close to the boat so there is no need to spend hours waiting, those photos are good, would have been even better to take more.	🙂

3.4 LONGLINE 4 (DARKENESS ISSUE)

Figure 6. Photo taken when hauling longline 4

Observer's comment :	It was so late in the evening I could still see them but pictures are way too dark, I've the impression that I wasted my time

Feedback to observer:

Quality	Too dark but not your fault.	😐
Informations on individuals	Many pictures of this series will be used to identify individuals despite darkness	🙂
Conclusion	One thing you can play with in those dark situations is to increase ISO to 1600. This time spent was certainly not wasted at all !!	🙂

Figure 7. Photo treatement to enlighten photos allowing to obtain information on individuals
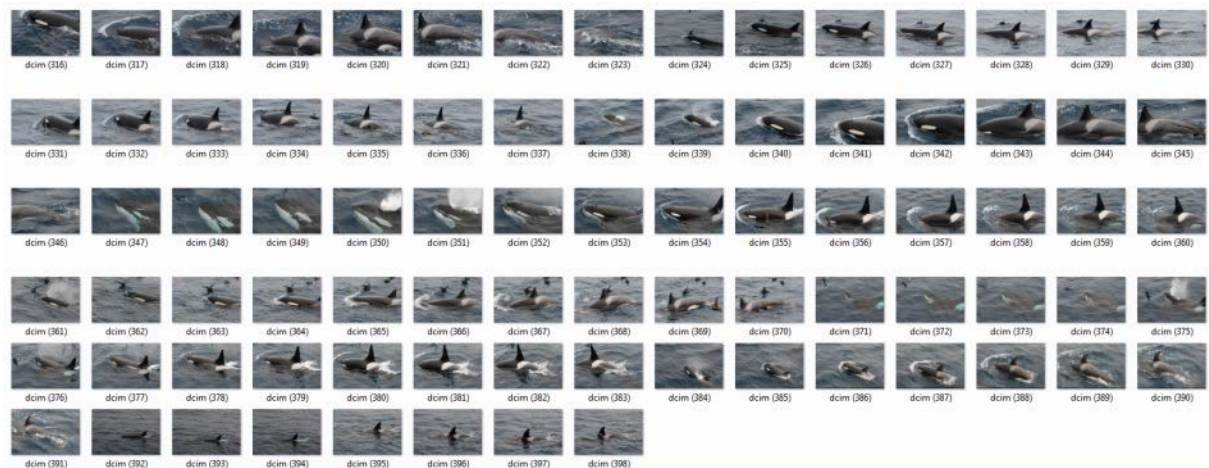
3.5 LONGLINE 5 (OPTIMIZED !)

Figure 8. Photo taken when hauling longline 5

Observer's comment :	15 minutes spent basically staying with the button pushed to take hundreds of pictures ! I'm worried it might be an issue to archive all this though

Feedback to observer:

Quality	Not all the same quality, some photos might not be used but overall the vast majority are very valuable pictures	🙂
Informations on individuals	Probably most individuals presents around the ship were covered here with pictures of fins and saddles so this is a huge amount of precious information!!	🙂🙂
Conclusion	That was really the best use of time spent taking pictures ! Archiving pictures and the volume of hard drives is not an issue.	🙂🙂

II. Can bridge cameras be used as an alternative to DSLR cameras? Field testing at Crozet

Ideally, photo-identification of killer whales should be conducted using DSLR cameras equipped with tele-lenses (400 mm). However, the so-called "bridge" cameras, although not offering as much performance as DSLR cameras, may still be used as smaller, cheaper, and easier-to-use alternative for opportunistic photo-identification. Unlike compact cameras or phone cameras, bridge cameras do have options to set up the shutter speed or to use burst mode or to quickly adjust the focus on the photographed animal, which are all key conditions for a good photograph of quickly moving species such as whales. Through comparisons with other types of equipment and results from at-sea testing, we investigated the advantages and constraints of the use of bridge cameras as an alternative way to collect photo-identification for fisheries in which this technique is poorly used or not used at all.

A Panasonic DC-FZ82 bridge camera was purchased in 2019 and its potential as an effective tool for photo-identification was evaluated versus a Canon EOS 700D DSLR body equipped with a 100-400mm lens (the standard equipment used by French fishery observers).
First testing were conducted at sea by an observer who tried the camera for photo-identification of killer whales interacting with a vessel at Crozet EEZ in September 2019.

Results

Results are presented in Table 1. The SLR EOS 700D + 100-400mm lens will be referred to as the "SLR system" in the document. Price is approximately ten times higher for the SLR system versus Bridge, their resolutions are high and comparable, burst mode reaches 10 frames per second in the Bridge camera versus 5 in the SLR system but the buffer memory and the writing speed on the memory card probably drive those values.

Dimensions and weight are very different; the SLR system is far heavier while the Bridge's size is very compact. Both systems provide a shutter priority mode, from our first trials with the Bridge camera, its quality will be sufficient when animals are near the ship (which is often the case for killer whales used to interact with fishing activities) but when animals are too far the zoom will be no match with the SLR system.

Table 1 Comparative summary of the use of a bridge camera vs. a DSLR camera with a telelens.

	SLR EOS 700D camera with 100-400 lens	Bridge camera Panasonic DC-FZ82
Price	2700 euros	279 euros (the price of a big Patagonian toothfish)
Camera Effective Pixels	18.0 Mpx	18.1 Mpx
Burst mode	5 frames/sec	10 frames/sec
dimensions	Very big	small
weight	>2300g	616 g
Shutter priority mode	Yes	yes
Quality when whales are far	🙂	🙂
Quality when whales are near	🙂	🙂

The main limitation of bridge cameras is their lack of details and drop in image quality when photographs of killer whales surfacing far from the vessel are taken. This drop in quality makes the identification of killer whale individuals on pictures harder and less reliable, especially for poorly-distinctive individuals (Figure 9 & Figure 10)

Figure 9 Two killer whales patterns of markings : on the left strong markings and on the right lighter markings.
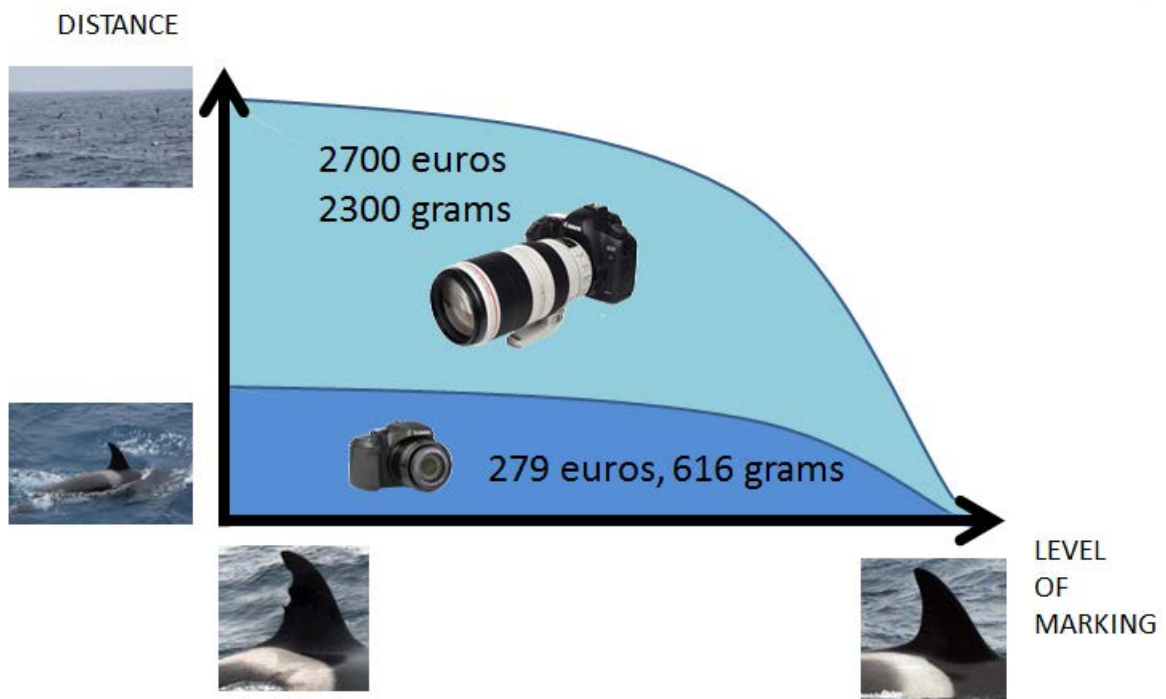
Figure 10 Areas of use for Bridge and SLR cameras to obtain best informative photos in regard of the level of marking and the distance to individuals

Conclusion

A bridge camera is undoubtedly more affordable and easier to handle than DSLR cameras equipped with telelenses. Results from the multiple tests indicated that the bridge camera, in situations when whales are close to the vessel, allows for photographs of sufficient quality to

be taken by observers during depredation interactions. As individuals, and especially killer whales, tend to surface close to the vessel while interacting with longlines, we encourage fisheries with no or low photo-identification effort to consider providing bridge cameras to their observers on vessels as a way to increase and improve that key aspect of research in toothfish fisheries.

However, the results also confirmed that bridge cameras still have a number of limitations (animals must be close to the ship to maximise quality) when compared to DSLRs equipped with telelenses. As such, we still recommend the use of DSLRs equipped with telelenses as a priority choice for fisheries wishing to develop photo-identification, and bridge cameras as an alternative option. From fishing vessels, photo-identification remains a tool with a far better ratio between costs of implementation and research productivity than any other research approach on cetaceans. As many aspects of the persisting whale depredation issue in fisheries have yet to be studied and understood, including aspects related to socio-economics, conservation, ecology and fish stock management (Tixier 2014a, Tixier 2014b, Tixier 2015), this study can help and further encourage fisheries facing this issue to implement consistent photo-identification effort from vessels (Gasco et al. 2013).

This paper tested one model but similar models of bridge cameras are likely to give the same results.

III. Bridge setting

Recommended settings :

White balance:	
Drive mode:	

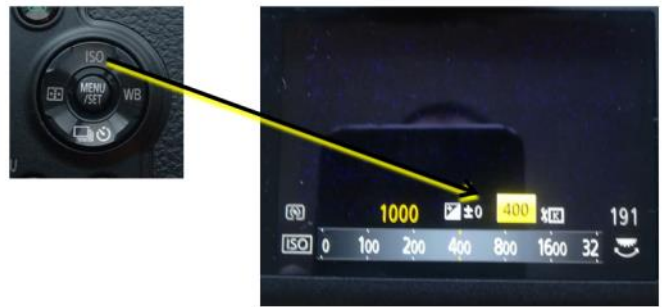|	
Autofocus mode:	
ISO Considering the size of the lens, 400 iso is a good compromise.	
Zoom Optical zoom can't give the same results as optical zoom, user should not use zoom over a maximum of 200 mm	
Shutter priority This mode "S" must be used And speed should be set to 1/1000 s	
In menus, set to burst rate	

Stabilizer must be switched on	Set image stabilizer Conversion — OFF Color Space — S RGB **Stabilizer — ((🖐))** 7/7 Face Recog. — OFF Profile Setup — OFF
Picture size must be set to maximum	Set picture size Photo Style — STD. Filter Settings — OFF Aspect Ratio — 4:3 1/7 **Picture Size — L 18M** Quality
Quality must be set to maximum	Set compression level of picture Photo Style — STD. Filter Settings — OFF Aspect Ratio — 4:3 1/7 Picture Size — L 18M **Quality — 🔲**

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