AQUATIC CONSERVATION: MARINE AND FRESHWATER ECOSYSTEMS
Aquatic Conserv: Mar. Freshw. Ecosyst. (2014)
Published online in Wiley Online Library
(wileyonlinelibrary.com). DOI: 10.1002/aqc.2446

Assessing sperm whale (Physeter macrocephalus) *movements within the western Mediterranean Sea through photo-identification*

EVA CARPINELLI[a,b,c,*], PAULINE GAUFFIER[a], PHILIPPE VERBORGH[a], SABINA AIROLDI[b], LÉA DAVID[d], NATHALIE DI-MÉGLIO[d], ANA CAÑADAS[e], ALEXANDROS FRANTZIS[f], LUKE RENDELL[g], TIM LEWIS[h], BARBARA MUSSI[i], DANIELA SILVIA PACE[i] and RENAUD DE STEPHANIS[j]

[a]*CIRCE (Conservation, Information and Research on Cetaceans), Cabeza de Manzaneda, Pelayo, Algeciras, Cadiz, Spain*
[b]*Tethys Research Institute, Milano, Italy*
[c]*CIBRA, Centro Interdisciplinare di Bioacustica e Ricerche Ambientali, University of Pavia, Italy*
[d]*EcoOcéan Institut, Montpellier, France*
[e]*Alnilam, Cándamo, Madrid, Spain*
[f]*Pelagos Cetacean Research Institute, Vouliagmeni, Greece*
[g]*Sea Mammal Research Unit, Scottish Oceans Institute, School of Biology, University of St. Andrews, St. Andrews, Fife, UK*
[h]*International Fund for Animal Welfare, London, UK*
[i]*Oceanomare Delphis Onlus, Rome, Italy*
[j]*GEMA, Department of Conservation Biology, Estación Biológica de Doñana (CSIC), Sevilla, Spain*

ABSTRACT

1. The Mediterranean sperm whale sub-population is considered 'Endangered' by both ACCOBAMS and the IUCN. Conservation policies require protected species populations to be monitored, but the distribution and movements of sperm whales across the Mediterranean Sea are still poorly understood.

2. To provide insight into sperm whale movements, the photo-identification catalogue from the Strait of Gibraltar was compared with seven other collections: (a) the North Atlantic and Mediterranean Sperm Whale Catalogue (NAMSC), and with photo-identification catalogues from (b) the Alboran Sea, Spain, (c) the Balearic Islands, Spain, (d) the Corso-Provençal Basin, France, (e) the Western Ligurian Sea, Italy, (f) the Tyrrhenian Sea, Italy and (g) the Hellenic Trench, Greece.

3. Of 47 sperm whales identified in the Strait of Gibraltar between 1999 and 2011 a total of 15 animals (32%) were photographically recaptured in other sectors of the western Mediterranean Sea in different years. None of the Strait of Gibraltar sperm whales were resighted in Atlantic waters or in the eastern Mediterranean basin.

4. These results indicate long-range movements of the species throughout the whole western Mediterranean Sea, with a maximum straight-line distance of about 1600 km. The absence of any photographic recaptures between the Mediterranean Sea and the North Atlantic Ocean supports the genetic evidence of an isolated sub-population within the Mediterranean Sea.

5. Long-term photo-identification efforts and data sharing between institutions should be further encouraged to provide basic information necessary for the implementation of effective sperm whale conservation measures in the whole basin.

*Correspondence to: Eva Carpinelli, CIRCE (Conservation, Information and Research on Cetaceans), Cabeza de Manzaneda n°3, Pelayo, 11390 Algeciras, Cadiz, Spain. E-mail: carpinelli.e@gmail.com

Copyright © 2014 John Wiley & Sons, Ltd.

Received 11 April 2012; Revised 1 October 2013; Accepted 9 January 2014

KEY WORDS: Strait of Gibraltar; photo-ID catalogues; Atlantic Ocean; Mediterranean sub-population; conservation; data sharing

INTRODUCTION

The sperm whale (*Physeter macrocephalus*, Linneus 1758), the largest of the toothed whales, has a cosmopolitan distribution, with a large latitudinal range (Whitehead, 2003). Genetic analyses suggest that sperm whales of the Mediterranean Sea are a semi-isolated sub-population (Drouot *et al*., 2004a; Engelhaupt *et al*., 2009). Despite no current overall abundance estimates for the Mediterranean sub-population, it appears that this sub-population has declined over the past 20 years (Cañadas *et al*., 2005; Aguilar and Borrell, 2007; Lewis *et al*., 2007; Pirotta *et al*., 2011). By-catch in driftnets targeting swordfish (Reeves and Notarbartolo di Sciara, Q1 2006), and ship strikes (Panigada *et al*., 2006; Q2 Di-Méglio *et al*., this volume) are two likely causes. The Mediterranean sperm whale sub-population is considered 'Endangered' according to ACCOBAMS and it has also been proposed that it should be included in the 'Endangered' category according to the International Union for the Conservation of Nature (IUCN) criteria (Reeves and Notarbartolo di Sciara, 2006; Notarbartolo di Sciara and Birkun, 2010). A better understanding of the movements of sperm whales within the Mediterranean basin could help in the development of effective conservation measures for this species.

Sperm whales depend on resources that vary in space and time, and movement is crucial for their survival (Jaquet *et al*., 2003). Both sexes are capable of performing long latitudinal and longitudinal migrations across oceanic basins. Recent photo-ID studies have shown that these movements can reach 4400 km for males moving between the Azores and Norway (Steiner *et al*., 2009). Similarly, while analysis of 'discovery–mark–recovery' data for sperm whales in the north Pacific has shown maximum movements recorded for females of 4332 km and 5178 km for males (Mizroch and Rice, in press). Sperm whales inhabiting semi-enclosed areas like the western Mediterranean Sea should be equally capable of performing such long movements, even if they are restricted by the Strait of Gibraltar (290 m deep) in the west, and the Sicily Sill (316 m deep) in the east. Because the Strait of Gibraltar is the only connection between the Mediterranean Sea and the Atlantic Ocean, and since sperm whales have been routinely observed there both in summer (de Stephanis *et al*., 2008) and winter (Gauffier *et al*., 2012), this is an interesting study area, allowing researchers to investigate whether sperm whales move between the Mediterranean and Atlantic. Previous results from multi-year monitoring surveys (Fernandez-Casado *et al*., 2001; de Stephanis, 2007; de Stephanis *et al*., 2008; Frantzis *et al*., 2011) are consistent with those from genetic studies (Drouot *et al*., 2004a; Engelhaupt *et al*., 2009) and indicate that there are minimal or irregular movements of sperm whales through the Strait of Gibraltar. The aim of this study is to compare the Strait of Gibraltar photo-identification catalogue with several other catalogues from different regions of the Mediterranean Sea and North Atlantic Ocean, trying to understand if there are regular movements of sperm whales between the Mediterranean Sea and the Atlantic Ocean and to look at possible long-range movements within the Mediterranean Sea.

METHODS

CIRCE's sperm whale photo-identification catalogue from the Strait of Gibraltar was compared with (a) the North Atlantic and Mediterranean Sperm Whale Catalogue (NAMSC, International Fund for Animal Welfare, updated until 2004) and with the photo-identification catalogues from (b) the Alboran Sea, Spain (Alnitak and Alnilam), (c) the Balearic Islands, Spain (Sea Mammal Research Unit-University of St Andrews) (d) the Corso-Provençal basin, France (EcoOcéan Institut), (e) the Western Ligurian Sea, Italy (Tethys Research Institute), (f) the Tyrrhenian Sea, Italy (Oceanomare Delphis), and (g) the Hellenic Trench, Greece (Pelagos Cetacean Research Institute).

Onlyflukes of solitary sperm whales (males and probable males) were used from this last catalogue. Catalogues are summarized in Table 1. T1

CIRCE's catalogue uses pictures taken from whale-watching platforms in 1999–2000 and from a research motorboat (10 m) between 2001 and 2011. The pictures were taken using film (in 1999–2003) and digital (in 2004–2011) professional cameras. The best slide for each sighting between 1999 and 2003 was scanned to make it available in digital format. An identification number was given to each individual identified in the catalogue. Matches with previously identified individuals were made by comparing each new photograph with all the others in the catalogue using two observers. This was done by eye without the use of matching software. The low number of photographs to be matched meant that matching in this way was both more accurate and time efficient. After comparing new pictures with the catalogue, individuals which had not been seen in earlier years were given a new identification number. During the study period in the Strait of Gibraltar, 47 individual sperm whales were photo-identified with high photo quality. The photo-identification catalogue from the Strait of Gibraltar was compared by naked eye with the better images in NAMSC (1344 lower quality photos Q quality index ≤ 3, according to Arnbom, 1987 were discarded), and with the other catalogues which all contained high quality photos.

RESULTS AND DISCUSSION

Table 2 summarizes all matches between the different catalogues. Out of CIRCE's 47 sperm whales from the Strait of Gibraltar, 15 animals (32%) were photographically recaptured in other sectors of the western Mediterranean Sea, all in different years. Four individuals were resighted in the Alboran Sea (maximum straight-line distance of about 400 km), three in the Balearic Islands (maximum straight-line distance of about 800 km), six in the western Ligurian Sea (maximum straight-line distance of about 1600 km), one individual both in the Alboran and the Ligurian Sea, and another one in the Alboran Sea, the Ligurian Sea and the Corso-Provençal basin (maximum straight-line distance of about 1200 km) (Figure 1 and 2; Table 2). None of the 47 sperm whales of the Strait of Gibraltar were resighted in North Atlantic waters, none in the Tyrrhenian Sea and none in the Hellenic Trench in Greece. These results show long-range bidirectional movements of sperm whales throughout the whole western Mediterranean Sea, with a maximum straight-line distance of about 1600 km. Resighted sperm whales show different individual movement patterns. The individual Pm_Gib_016 showed bi-directional movements between the Strait of Gibraltar, a feeding area (de Stephanis *et al.*, 2008), and the Balearic Islands, which are believed T2 F1 F2

Table 1. Features of the catalogues compared for this project

Geographical area	Contributors	Catalogue features	Years
Strait of Gibraltar Spain	CIRCE (Conservation, Information and Research on Cetaceans)	47 individuals 310 sightings	1999–2011
Alboran Sea Spain	Alnitak Marine Research Center	11 individuals 7 sightings	2006–2008
Balearic Islands Spain	University of St. Andrews	57 individuals 168 sightings	2003–2008
Corso-Provençal basin France	EcoOcéan Institut	35 individuals 91 sightings	1994–2010
Ligurian Sea Italy	Tethys Research Institute	105 individuals 193 sightings	1990–2010
Tyrrhenian Sea Italy	Oceanomare Delphis	57 individuals 90 sightings	2003–2011
Hellenic Trench Greece	Pelagos Cetacean Research Institute	33 individuals 77 sightings	1998–2009
North Atlantic Ocean	NAMSC North Atlantic and Mediterranean Sperm whales Catalogue (IFAW) (Only the pictures of the North Atlantic are included)	4167 high quality photos	1994–2004

Table 2. Details of sperm whales resighted in different areas of the Mediterranean Sea.

Whale code	N	Geographical area	Dates of encounters
Pm_Gib_004	11	Strait of Gibraltar	17 May 2001, 4 August 2001, 9 August 2001, 1 May 2003, 25 May 2003, 30 May 2007, 17 June 2007, 19 June 2007, 22 June 2007, 9 July 2007
		Alboran Sea	21 June 2008
Pm_Gib_006	8	Ligurian Sea	14 Sept 1999
		Strait of Gibraltar	6 July 2001, 8 July 2001, 12 July 2001, 9 August 2001, 20 August 2001, 17 June 2007, 9 July 2007
Pm_Gib_016	3	Strait of Gibraltar	1 May 2003, 15 June 2005
		Balearic Islands	29 July 2004
Pm_Gib_022	18	Alboran Sea	15 June 1999
		Strait of Gibraltar	17 August 1999, 13 July 1999, 19 July 2003, 15 June 2005, 20 May 2006, 18 June 2006, 19 June 2006, 23 June 2006, 26 June 2006, 5 July 2007, 3 March 2007, 22 May 2007, 19 June 2007, 22 June 2007, 3 July 2007, 9 July 2007, 21 November 2010
Pm_Gib_023	6	Ligurian Sea	12 August 2003, 21 August 2003, 22 August 2003, 18 September 2004
		Strait of Gibraltar	19 June 2006, 26 June 2006
Pm_Gib_025	5	Strait of Gibraltar	5 June 2000, 13 July 2003, 17 July 2003, 3 March 2007
		Ligurian Sea	28 July 2007
Pm_Gib_027	3	Strait of Gibraltar	30 May 2007, 22 June 2007
		Alboran Sea	21 June 2008
Pm_Gib_032	3	Alboran Sea	10 September 2002, 20 June 2008
		Strait of Gibraltar	13 April 2008
Pm_Gib_034	2	Strait of Gibraltar	13 April 2008
		Ligurian Sea	18 June 2009
Pm_Gib_037	3	Alboran Sea	20 June 2008
		Strait of Gibraltar	29 July 2008
		Ligurian Sea	14 August 2009
Pm_Gib_040	2	Ligurian Sea	7 August 2001
		Strait of Gibraltar	2 September 2008
Pm_Gib_042	2	Balearic Islands	27 July 2007
		Strait of Gibraltar	12 May 2009
Pm_Gib_043	6	Ligurian Sea	7 September 2007
		Alboran Sea	21 June 2008
		Strait of Gibraltar	16 May 2009, 17 May 2009, 23 February 2011
		Corso-Provençal basin	29 July 2010
Pm_Gib_045	2	Ligurian Sea	7 September 2007
		Strait of Gibraltar	17 May 2009
Pm_Gib_048	2	Balearic Islands	25 July 2006
		Strait of Gibraltar	6 May 2010

N: number of encounters of each individual

to have an important role as a breeding ground (Gannier *et al*., 2002; Drouot-Dulau and Gannier, 2007; Pirotta *et al*., 2011), while Pm_Gib_043 moved between two feeding areas (Strait of Gibraltar and Ligurian Sea) (Figure 1) (Drouot *et al*., 2004b; de Stephanis *et al*., 2008). However, other individuals showed site fidelity over the years (e.g. Pm_Gib_022; Figure 1; Table 2). Sperm whales appear to move through the whole western Mediterranean Sea, consistent with the analysis of Rendell *et al*. (this volume) who found six matches between the Ligurian Sea and the Balaeric Islands based on a catalogue of 180 individuals collected over 18 years.

Social groups of females with calves are routinely encountered in the Balearic Islands, Hellenic Trench and Tyrrhenian Sea (Frantzis *et al*., 2003; Rendell *et al*., This volume; Mussi *et al*., 2005; Drouot *et al*., 2007; Pirotta *et al*., 2011). In contrast, in both the Strait of Gibraltar and Ligurian Sea, social groups with females and calves have rarely been observed over the last two decades (Gannier *et al*., 2002). This could indicate that female groups are more sedentary than males making the sub-population even more vulnerable.

The absence of any photographic recaptures between the Strait of Gibraltar and the North Atlantic Ocean is consistent with the

Figure 1. Individuals from the Strait of Gibraltar resighted in the Mediterranean Sea. Numbers indicate chronological order of observation.

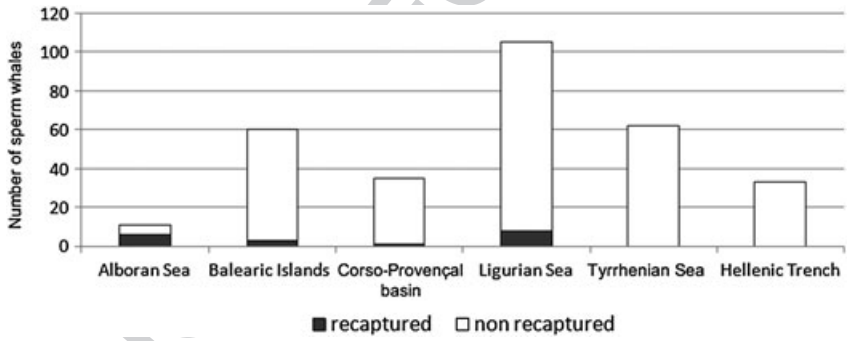


Figure 2. Number of sperm whales of the Strait of Gibraltar photographically recaptured in different areas of the Mediterranean Sea.

results obtained by Drouot *et al.* (2004a) and Engelhaupt *et al.* (2009), who suggested the existence of a genetically isolated Mediterranean sub-population.

NAMSC contains over 2350 images from the Azores as well as images from the Canary Islands, Madeira, Cape Verde and Atlantic Iberia (overall total 2451) and the lack of photo-identification matches with the

Table 3. Performed and non-performed matching between sperm whale photo-ID catalogues from different Mediterranean areas

	Strait of Gibraltar	Alboran Sea	Balearic Islands	Corso-Provençal basin	Ligurian Sea	Tyrrhenian Sea
Alboran Sea	This study					
Balearic Islands	This study	Carpinelli*et al.*, 2012				
Corso-Provençal basin	This study	no	no			
Ligurian Sea	This study	Carpinelli *et al.*, 2011	Rendell *et al.*,	No		
Tyrrhenian Sea	This study	no	No	No	Tethys and Oceanomare Delphis unpublished data	
Hellenic Trench	This study	This study	This study	This study	Frantzis *et al.*, 2011	This study

Atlantic individuals is strong evidence that the movement is predominantly, though not necessarily exclusively between the Strait of Gibraltar and the Mediterranean Sea rather than between the Strait and the Atlantic Ocean. However, there are few images in NAMSC from the Atlantic areas in the immediate vicinity of the Strait of Gibraltar, such as the Gulf of Cadiz, Portugal or Morocco.

Sperm whales are listed as *Endangered* in the Mediterranean Sea (Reeves and Notarbartolo di Sciara, 2006). They are threatened by many anthropogenic factors that are exacerbated in this region because of the enclosed geography of the Mediterranean Sea, and the large human populations that surround it, and the high level of activity within it. These factors include marine traffic, noise, interactions with fisheries, ingestion of plastic debris (de Stephanis *et al.*, 2013). Conservation efforts are, however, hampered by a lack of knowledge about the population biology of the sperm whales that inhabit the Mediterranean Sea and the degree to which there is population structure within the Mediterranean Sea itself. Studies such as this one are important in helping us understand the extent to which the Mediterranean population might be further subdivided across the various basins.

Results show that there is an exchange of male sperm whales within the whole western Mediterranean basin (see also Rendell *et al.*, this volume) but there is no evidence of movements between the Atlantic and Mediterranean Sea. This means that effective conservation requires efforts that cross national boundaries, focused for example on the implementation of international monitoring programmes. Furthermore this study confirms that photo-identification is an effective, non-invasive technique to monitor cetacean movements over several years, which can be applied on a basin-wide scale. The comparison of all existing and available sperm whale photo-identification material for the Mediterranean Sea should help to obtain baseline information on the species' abundance, distribution and population trends. Other research institutions could be involved in monitoring sperm whales using photo-identification, and whale watching companies could make a substantial contribution. The establishment of a

coordinated database and agreed standards and database formats between collections will help coordinated analysis in the future.

ACKNOWLEDGEMENTS

We are grateful to IFAW and all the 34 contributors of the North Atlantic and Mediterranean Sperm whale Catalogue. Special thanks are due to Alnitak for contributing sightings and pictures data. Thanks to Portosole and Canon, Ministerio de Medio Ambiente, Fundacion Biodiversidad, Fundación Loro Parque, CEPSA, LIFE02NAT/E/8610, Consejeria de Medio Ambiente de la Junta de Andalucia for funding. Thanks to Turmares S.L. and Firmm for their collaboration. We would like to thank all the research assistants, volunteers, and skippers who took part in data collection and Dr Rocco Tiberti for his helpful comments on this manuscript. De Stephanis was supported by the spanish 'Ministerio de Economía y Competitividad' through the 'Subprograma Juan de la Cierva'. Thanks are also due to the IFAW for providing the software Logger 2000.

REFERENCES

Aguilar A, Borrell A. 2007. Open-boat whaling on the Straits of Gibraltar ground and adjacent waters. *Marine Mammal Science* **23**: 322–342.

Arnbom T. 1987. Individual identification of sperm whales. *Report of the International Whaling Commission* **37**: 201–204.

Cañadas A, Sagarminaga R, de Stephanis R, Urquiola E, Hammond PS. 2005. Habitat preference modelling as a conservation tool: proposals for marine protected areas for cetaceans in southern Spanish waters. *Aquatic Conservation: Marine and Freshwater Ecosystems* **15**: 495–521.

Di-Méglio N, David L, Di Fulvio T, Monestiez P. submitted. Evaluation of the potential of collision between sperm whales and maritime traffic in PELAGOS Sanctuary in the north-western Mediterranean Sea in summer, and mitigation solutions. *Aquatic Conservation: Marine and Freshwater Ecosystems*. Q7

Drouot V, Bérubé M, Gannier A, Goold JC, Reid RJ, Palsbøll PJ. 2004a. A note on genetic isolation of Mediterranean sperm whales (*Physeter macrocephalus*) suggested by mitochondrial DNA. *Journal of Cetacean Research and Management* **6**: 29–32.

Drouot V, Gannier A, Goold JC. 2004b. Summer social distribution of sperm whales (*Physeter macrocephalus*) in the Mediterranean Sea. *Journal of the Marine Biological Association of the United Kingdom* **84**: 675–680.

Drouot-Dulau V, Gannier A. 2007. Movements of sperm whales in the western Mediterranean Sea: preliminary photo-identification results. *Journal of the Marine Biological Association United Kingdom* **87**: 195–200.

Engelhaupt D, Hoelzel AR, Nicholson C, Fratzis A, Mesnick S, Gero S, Whitehead H, Rendell L, Miller P, de Stephanis R, *et al*. 2009. Female philopatry in coastal basins and male dispersion across the North Atlantic in a highly mobile marine species, the sperm whale (*Physeter macrocephalus*). *Molecular Ecology* **18**: 4193–4205.

Fernandez-Casado M, Perez Gimeno N, de Stephanis R. 2001. Occurrence of sperm whale (*Physeter macrocephalus*) in the Strait of Gibraltar: evidences for site fidelity. In *European Research on Cetaceans 15. Proceedings of the 15th Annual Conference of the European Cetacean Society*, Evans PGH, O'Boyle E (eds). European Cetacean Society: Rome; 416–419.

Frantzis A, Alexiadou P, Paximadis G, Politi E, Gannier A, Corsini-Foka M. 2003. Current knowledge of the cetacean fauna of the Greek Seas. *Journal of Cetacean Research and Management* **5**: 219–232.

Frantzis A, Airoldi S, Notarbartolo di Sciara G, Johnson C, Mazzariol S. 2011. Inter-basin movements of Mediterranean sperm whales provide insight into their population structure and conservation. *Deep-Sea Research* **58**: 454–459.

Frantzis A, Alexiadou P, Gkikopoulou K. 2013. Sperm whale occurrence, site fidelity and population structure along the Hellenic Trench (Greece, Mediterranean Sea). *Aquatic Conservation.* Q8 Q9

Gannier A, Drouot V, Goold JC. 2002. Distribution and relative abundance of sperm whales in the Mediterranean Sea. *Marine Ecology Progress Series* **243**: 281–293.

Gauffier P, Moral Cendón M, Blasi A, Carpinelli E, Jiménez Torres C, Giménez Verdugo J, Esteban R, de Stephanis R, Verborgh P. 2012. Winter presence of large cetaceans in the Strait of Gibraltar. 26th Annual Meeting European Cetacean Society, Galway, Ireland, 26–28 March 2012.

Ivashin MV. 1967. Whale globe-trotter. *Priroda* **8**: 105–107. Q10

Jaquet N, Gendron D, Coakes A. 2003. Sperm whales in the Gulf of California: residency, movements, behavior, and the possible influence of variation in food supply. *Marine Mammal Science* **19**: 545–562.

Lewis T, Gillespie D, Lacey C, Matthews J, Danbolt M, Leaper R, McLanaghan R, Moscrop A. 2007. Sperm whale abundance estimates from acoustic surveys on the Ionian Sea and Straits of Scicily in 2003. *Journal of the Marine Biological Association of the United Kingdom* **87**: 353–357.

Mizroch S, Rice D. in press. Distribution and movements of sperm whales in the North Pacific shown by whaling data and Discovery marks. *Marine Mammal Science*. Q11

Mussi B, Miragliuolo A, Pace DS. 2005. Acoustic and behaviour of sperm whale nursery groups in the waters of Ischia, Italy. *European Research on Cetaceans* **19**. Q12

Notarbartolo di Sciara G, Birkun A Jr. 2010. *Conserving whales, dolphins and porpoises in the Mediterranean and Black Seas: an ACCOBAMS status report, 2010*. ACCOBAMS: Monaco.

Panigada S, Pesante G, Zanardelli M, Capoulade F, Gannier A, Weinrich MT. 2006. Mediterranean fin whales at risk from fatal ship strikes. *Marine Pollution Bulletin* **52**: 1287–1298.

Pirotta E, Matthiopoulos J, MacKenzie M, Scott-Hayward L, Rendell L. 2011. Modelling sperm whale habitat preference: a novel approach combining transect and follow data. *Marine Ecology* **436**: 257–272.

Reeves R, Notarbartolo di Sciara G. 2006. *The Status and Distribution of Cetaceans in the Black Sea and Mediterranean Sea*. IUCN Centre for Mediterranean Cooperation: Malaga, Spain.

Rendell L, Simião S, Brotons JM, Airoldi S, Fasano D, Gannier A. This volume. Population size and movements of Q13 sperm whales in the western Mediterranean basin.

Steiner L, Lamoni L, Acosta Plata M, Lewis T, Beer C, Gordon J, Pettersson L, Domingo M, Lettevall E, Jensen S-K. 2009. Long distance movement of sperm whales, *Physeter macrocephalus*, in the North Atlantic: including new matches between the Azores and Norway. Poster Presentation. The Society for Marine Mammalogy Conference, Quebec City, 2009.

de Stephanis R. 2007. Estrategias de alimentación de los diferentes grupos de Calderón común (*Globicephala melas*) en el Estrecho de Gibraltar. Implicaciones para su conservación. PhD thesis, Universidad de Cádiz.

de Stephanis R, Cornulier T, Verborgh P, Salazar Sierra J, Pérez Gimeno N, Guinet C. 2008. Summer spatial distribution of cetaceans in the Strait of Gibraltar in relation to the oceanographic context. *Marine Ecology Progress Series* **353**: 272–288.

de Stephanis R, Gomez J, Carpinelli E, Gutierrez-Exposito C, Cañadas A. 2013. As main meal for sperm whales: plastics debris. *Marine Pollution Bulletin* **69**: 206–214.

Whitehead H. 2003. *Sperm Whales: Social Evolution in the Ocean*. University of Chicago: Chicago.

Author Query Form

Journal: Aquatic Conservation: Marine and Freshwater Ecosystems

Article: aqc_2446

Dear Author,

During the copyediting of your paper, the following queries arose. Please respond to these by annotating your proofs with the necessary changes/additions.

- If you intend to annotate your proof electronically, please refer to the E-annotation guidelines.
- If you intend to annotate your proof by means of hard-copy mark-up, please refer to the proof mark-up symbols guidelines. If manually writing corrections on your proof and returning it by fax, do not write too close to the edge of the paper. Please remember that illegible mark-ups may delay publication.

Whether you opt for hard-copy or electronic annotation of your proofs, we recommend that you provide additional clarification of answers to queries by entering your answers on the query sheet, in addition to the text mark-up.

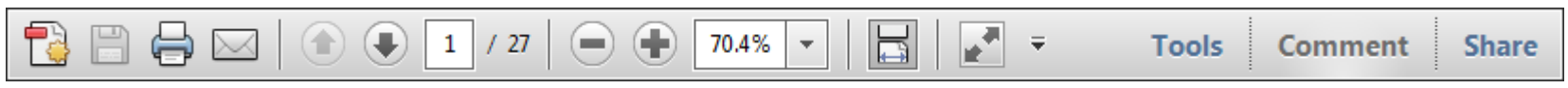
Query No.	Query	Remark
Q1	AUTHOR: The citation "Reeves et al., 2006" (original) has been changed to "Reeves and Notarbartolo di Sciara, 2006". Please check if appropriate.	
Q2	AUTHOR: The citation "Di-Meglio et al., this volume" (original) has been changed to "Di-Méglio et al., submitted". Please check if appropriate..	
Q3	AUTHOR: Not in Ref List.	
Q4	AUTHOR: Not in Ref List.	
Q5	AUTHOR: The citation "this volume" (original) has been changed to "Rendell et al., This volume". Please check if appropriate.	
Q6	AUTHOR: Not in Ref List.	
Q7	AUTHOR: Latest info required, this journal.	
Q8	AUTHOR: Reference "Frantzis et al. (2013)" is not cited in the text. Please indicate where it should be cited; or delete from the reference list.	
Q9	AUTHOR: Latest info required, this journal.	
Q10	AUTHOR: Reference "Ivashin (1967)" is not cited in the text. Please indicate where it should be cited; or delete from the reference list.	
Q11	AUTHOR: Latest info required.	
Q12	AUTHOR: Page range required.	
Q13	AUTHOR: Latest info required.	
Q14	AUTHOR: Table 3 has not been mentioned in the text. Please cite the table in the relevant place in the text.	

WILEY-BLACKWELL

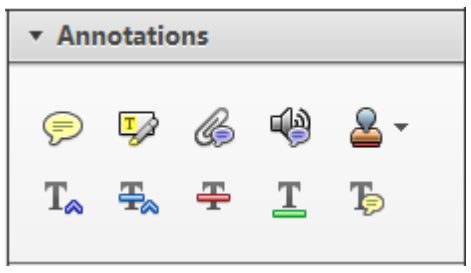
USING e-ANNOTATION TOOLS FOR ELECTRONIC PROOF CORRECTION

Required software to e-Annotate PDFs: Adobe Acrobat Professional or Adobe Reader (version 7.0 or above). (Note that this document uses screenshots from Adobe Reader X)
The latest version of Acrobat Reader can be downloaded for free at: http://get.adobe.com/uk/reader/

Once you have Acrobat Reader open on your computer, click on the Comment tab at the right of the toolbar:



This will open up a panel down the right side of the document. The majority of tools you will use for annotating your proof will be in the Annotations section, pictured opposite. We've picked out some of these tools below:

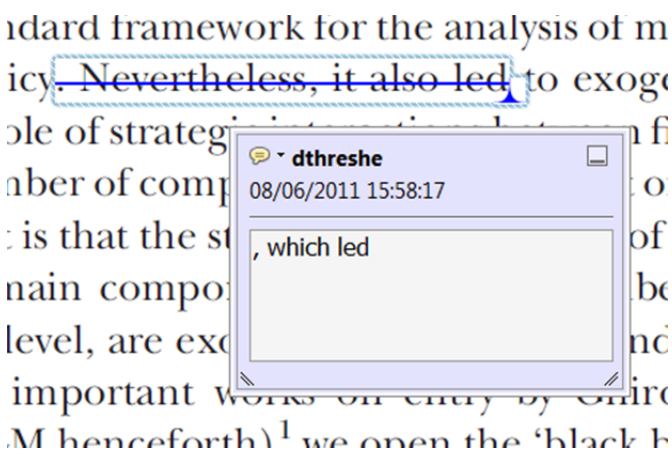


1. Replace (Ins) Tool – for replacing text.

Strikes a line through text and opens up a text box where replacement text can be entered.

How to use it

- Highlight a word or sentence.
- Click on the Replace (Ins) icon in the Annotations section.
- Type the replacement text into the blue box that appears.

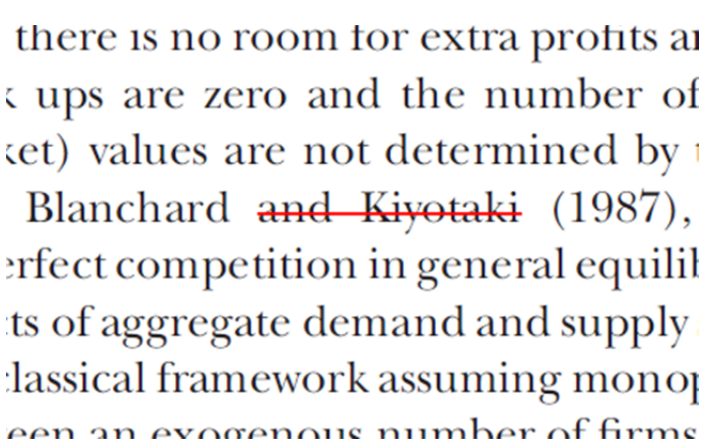


2. Strikethrough (Del) Tool – for deleting text.

Strikes a red line through text that is to be deleted.

How to use it

- Highlight a word or sentence.
- Click on the Strikethrough (Del) icon in the Annotations section.

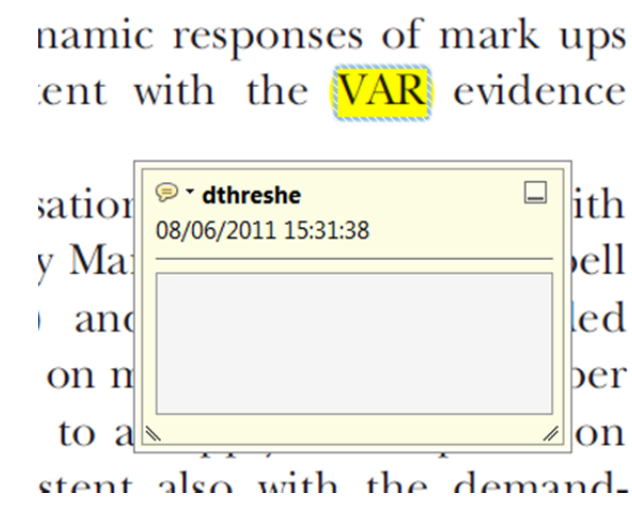


3. Add note to text Tool – for highlighting a section to be changed to bold or italic.

Highlights text in yellow and opens up a text box where comments can be entered.

How to use it

- Highlight the relevant section of text.
- Click on the Add note to text icon in the Annotations section.
- Type instruction on what should be changed regarding the text into the yellow box that appears.

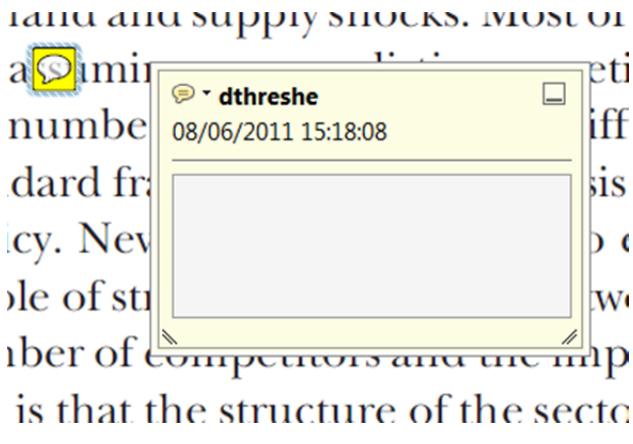


4. Add sticky note Tool – for making notes at specific points in the text.

Marks a point in the proof where a comment needs to be highlighted.

How to use it

- Click on the Add sticky note icon in the Annotations section.
- Click at the point in the proof where the comment should be inserted.
- Type the comment into the yellow box that appears.



WILEY-BLACKWELL

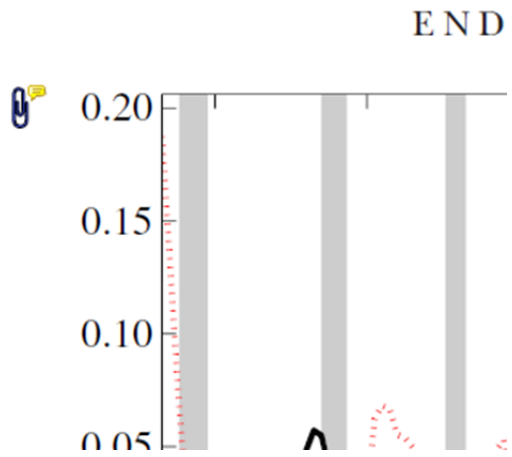
USING e-ANNOTATION TOOLS FOR ELECTRONIC PROOF CORRECTION

5. Attach File Tool – for inserting large amounts of text or replacement figures.

Inserts an icon linking to the attached file in the appropriate pace in the text.

How to use it

- Click on the Attach File icon in the Annotations section.
- Click on the proof to where you'd like the attached file to be linked.
- Select the file to be attached from your computer or network.
- Select the colour and type of icon that will appear in the proof. Click OK.

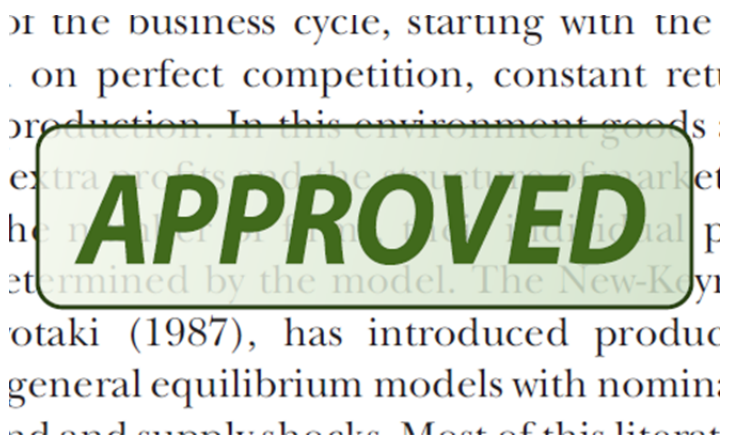


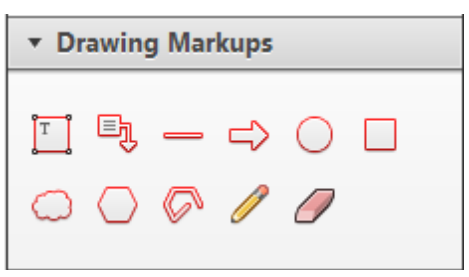
6. Add stamp Tool – for approving a proof if no corrections are required.

Inserts a selected stamp onto an appropriate place in the proof.

How to use it

- Click on the Add stamp icon in the Annotations section.
- Select the stamp you want to use. (The Approved stamp is usually available directly in the menu that appears).
- Click on the proof where you'd like the stamp to appear. (Where a proof is to be approved as it is, this would normally be on the first page).



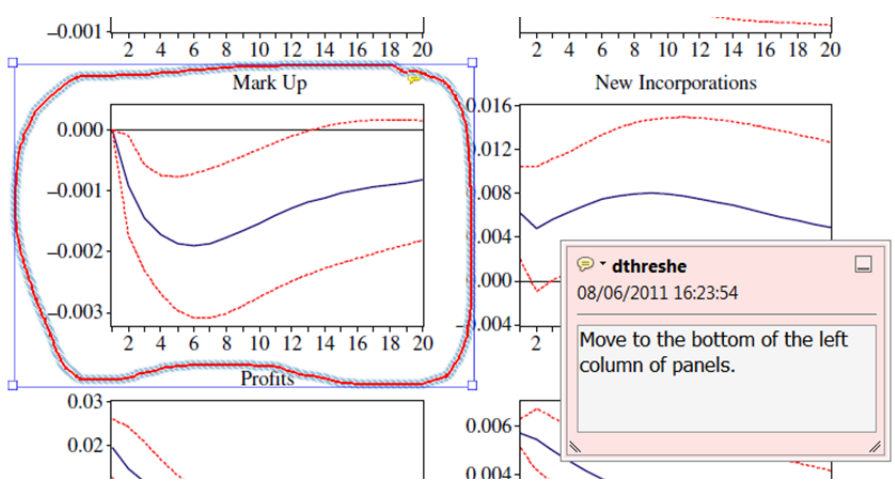


7. Drawing Markups Tools – for drawing shapes, lines and freeform annotations on proofs and commenting on these marks.

Allows shapes, lines and freeform annotations to be drawn on proofs and for comment to be made on these marks..

How to use it

- Click on one of the shapes in the Drawing Markups section.
- Click on the proof at the relevant point and draw the selected shape with the cursor.
- To add a comment to the drawn shape, move the cursor over the shape until an arrowhead appears.
- Double click on the shape and type any text in the red box that appears.



For further information on how to annotate proofs, click on the Help menu to reveal a list of further options: