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Cetacean Frustration: The Representation of Whales and Dolphins in Picture Books for Young Children

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Abstract To enable children to develop towards becoming part of the solution to environmental problems, it is essential that they are given the opportunity to become familiar with the natural world from early childhood. Familiarity is required to develop understanding of, care for and, ultimately, action in terms of protecting the natural world. As adult-led reading of picture books is a common form of indirect exposure to the natural world for young children, this study examines the biological accuracy of the representation of whales and dolphins in the images and text of picture books. Of the total of 116 books examined, 74 (63.8%) had errors in the representation of cetaceans in the images and/or text. Errors were identified in both fictional (mean = 8.0 errors/book, SD = 11.1, n = 55) and non-fictional (mean = 2.3 errors/book, SD = 4.9, n = 61) books. The potential impact of the errors is discussed, and suggestions are made as to how the impact could be reduced and how the biological accuracy of picture books could be improved.

Keywords Early childhood education · Learning and development · Science · Literacy development · Emergent environmental awareness

Introduction

Recent centuries have seen a dramatic increase in species extinction rates, with warnings that the window of opportunity to avert large-scale biodiversity decay, and the subsequent loss of the multitude of benefits from ecosystems that we all depend on, is rapidly closing (Ceballos et al. 2015). An increased level of environmental awareness and concern is required in the general population for action to be taken before this window closes. Becoming familiar with nature and developing an understanding of how organisms live are crucial steps towards caring about the environment, and towards wanting to help solve environmental problems. This familiarity with the natural world needs to begin during childhood, and inclusion of information about organisms native to the areas geographically close to the child would be helpful in developing the type of roles in community-based sustainable development advocated by Hart (1997). During the past decade, efforts have been made to improve primary science education (Alake-Tuenter et al. 2013). Encouraging children to engage more with nature, within outdoor areas of nursery and school grounds or on field trips, has been shown to influence students' learning attitudes and motivation towards environmental science (Nadelson and Jordan 2012). Clearly there are limits (geographically and financially) to the ecosystems that children can be exposed to directly, and indoor learning must also form an important part of environmental science education. Literature is a valuable way to introduce young children to environmental science (Wells and Zeece 2007), with Sackes

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et al. (2009) reporting a growing consensus among researchers that children's literature including picture books, both fiction and non-fiction, can be used as instructional tools to teach science. Royce and Wiley (1996) comment that the use of trade books [defined by Schussler (2008) as books marketed to a general audiences versus books created for a specialized audience such as text books] makes science education a more reasonable expectation for elementary teachers who perceive teaching science as difficult due to their limited exposure to formal science instruction during teacher training.

Books are also employed in a wide range of indoor activities that do not specifically focus on science, and reading aloud to young children is thought to be pivotal in building the knowledge required for development of a child's own reading skills (Bortnem 2008). As children develop as readers, they rapidly come to regard books as a particularly reliable source of information (Corriveau et al. 2014). Children under the age of eight often cannot make clear distinctions between texts based on reality and fantasy (Wells and Zeece 2007) and therefore are unlikely to distinguish between learning-to-read (where the main focus is on developing reading skills) and reading-to-learn (where the main focus is on information contained) texts. Indeed, the confusion with this distinction has also been reported for teachers (O'Brien and Stewart 1990). Information about the natural world is therefore being assimilated from all sources available to a child, and scientifically inaccurate representations of organisms in images and text in books can be viewed as more authoritative than the spoken word of parents with higher degrees in biological science (personal experiences of authors). Images are important in engaging children in the text and can form the basis of expanded discussion and other activities (Piro 2002) so it is important in the context of learning about the natural world that that basis is a good starting point. The accuracy of images within children's literature has previously been examined with Tundle et al. (2008) finding 20 % of representations of the moon in 80 children's texts were found to be non-scientific. Schussler (2008) examined how plant reproduction is represented in the images and text of 69 children's books and expressed concerns that what children might learn about plants from the books will not help them understand the mechanism of sexual reproduction in flowering plants. Schussler (2008) gives examples of errors identified including where the names of plants structures and processes have been confused by the authors of children's books.

This study aims to examine the scientific accuracy of visual and written representations of cetacea—such as whales, dolphins and porpoises—in children's literature. Cetacea were selected as the focus for this study as they are popular species in children's literature that the vast majority of school grounds and field trips were unlikely to be able to give students direct experience of, thus adding to the importance of their accurate representation in other information sources. Low levels of understanding of the marine environment have been identified in many countries (Guest et al. 2015). To date a total of 87 cetacean species have been evaluated for the IUCN Red List, the majority of which (45 species) are currently listed as Data Deficient (IUCN Cetacean Specialist Group 2015). Of the species where sufficient data have been collected, two are listed as Critically Endangered, seven as Endangered, six as Vulnerable, and five as Near Threatened. The WWF Species Action Plan for marine and freshwater cetaceans outlines the main threats to cetaceans: bycatch and entanglement, commercial whaling, unsustainable direct takes, ship strikes, marine debris, acoustic and chemical pollution, destruction of habitat, climate change, and poorly managed whale and dolphin watching (Burgener et al. 2012). As all of these threats are wholly or partially caused by humans, developing an understanding of these organisms among the next generation assumes even greater importance.

Methods

Twenty-one children's picture books from the authors' own home libraries featuring at least one image of a cetacean were initially identified to review common categories of errors in the representation of these species. Table 1 shows the categories identified with a brief description of the kinds of errors considered to belong to each category. In line with the biological approach of this study, cetaceans communicating in English, a common narrative style in children's literature, was not necessarily regarded as an error. If, however, the dialogue contained factually incorrect information, this was recorded as an error in the Text category.

A 3-month search was then conducted (June–August, 2013) for children's English language picture books including at least one image of a cetacean. Searches for potential texts were carried out on the Derbyshire County Council on-line library catalogue (Derbyshire County Council 2014) using the search terms "dolphin", "whale" and "marine mammal", in addition to manual searches of the Kedleston Road Library, University of Derby, and of the home libraries of the authors. All encountered books meeting the criteria were included in the study.

Texts were placed into one of two categories: fiction or non-fiction. A text could be placed in the non-fiction category even if it was written about the cetacean in the first person (i.e. wording such as "I have smooth skin to allow me so slip through the water easily" could be found in a text placed in the non-fiction category). The species depicted in the text was recorded. Some texts depicted more than

Table 1 Number of texts with errors in each of nine identified categories

Error category	Description	Number of texts (%) observed with errors in this category		
		Fiction	Non fiction	All texts
Tail orientation	Cetaceans have a horizontal caudal (tail) fin. An image was considered erroneous if the caudal fin was vertical (as is found in the majority of fish species)	10 (18.2%)	6 (9.8%)	16 (13.8%)
Number of blowholes	Odontoceti (toothed whales) have one blowhole, while Mysteceti (baleen whales) have two. An image was considered erroneous if no blowhole(s) was shown, or if the wrong number was shown for the species depicted	34 (61.8%)	17 (27.9%)	51 (44.0%)
Nature of blow	Whales are mammals and thus breathe air. A blow (when the whale breathes out at the surface) contains small amounts of mucus and seawater from around the blowhole(s), but is predominantly gaseous. An image was considered erroneous if a spout of water was coming out of the blowhole(s)	15 (27.3%)	8 (13.1%)	23 (19.8%)
Teeth	Odontoceti have teeth, while Mysticeti have baleen. An image was considered to be erroneous if a species was depicted with teeth that does not possess teeth, or if teeth were depicted as grossly wrong in position, number, shape or size	7 (12.7%)	5 (8.2%)	12 (10.3%)
Location	An image was considered erroneous if a species was depicted outwith its natural range (e.g. in a pond) or in an unnatural position in the water (e.g. floating on top like a rubber duck)	16 (29.1%)	4 (6.6%)	20 (17.2%)
Body position	An image was considered erroneous if an individual was in an unnatural body position (e.g. biting its own tail)	23 (41.8%)	6 (9.8%)	29 (25.0%)
Diet	An image was considered erroneous if a species was shown eating a dietary item it does not, or is unable to, consume in the wild. Cetaceans are carnivorous, so errors were recorded, for example, when cetaceans were depicted eating grass or bread. An error was also recorded if a Cetacean was depicted eating a food item it would be impossible to swallow due to the diameter of the esophagus (e.g. a blue whale eating a mature sea turtle)	8 (14.5%)	4 (6.6%)	12 (10.3%)
Cetacean interactions	An image was considered erroneous if a species of cetacean was depicted interacting with other species in an impossible or unnecessary way (e.g. a human shown entering the mouth and coming out of the blowhole, wild cetaceans relying on humans to feed them, or a narwhal depicted as the best friend of a penguin when their distributions mean the species would never encounter one another in the wild)	12 (21.8%)	4 (6.6%)	16 (13.8%)
Text	An error was recorded if the text included factually incorrect information about cetaceans (e.g. referring to a group of whales as a "school" rather than a pod; stating that whales spout water from the blowhole)	15 (27.3%)	9 (14.8%)	24 (20.7%)

Error categories originally derived from a pilot study of 21 children's picture books featuring at least one image of a cetacean. In total, 116 texts were reviewed (55 fiction, 61 non fiction)

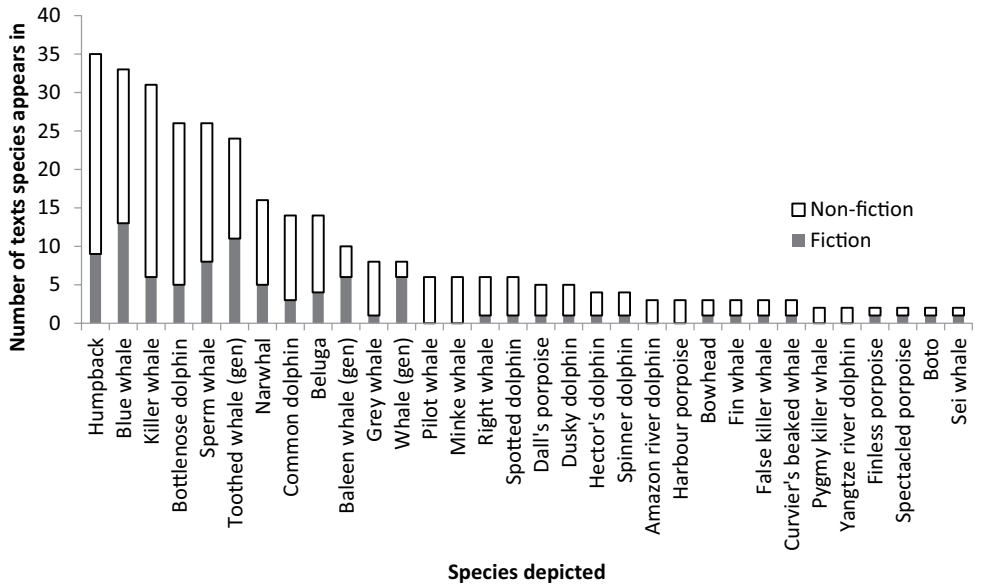

Fig. 1 Species represented in fictional and non-fictional texts for species with a minimum of two observations in the texts studied. Total number of texts examined was 116, of which 55 were fictional and 61 were non-fictional texts

one species and in such cases each species depicted was recorded. In some cases it was not possible to determine the cetacean depicted to species level due to the lack of identifying features present in the drawings. In such cases, general categories for "toothed whale", "baleen whale" and "whale" were employed based on the features available in the image for identification. Texts were reviewed independently by the same two researchers and the total number of errors identified in each of the categories shown in Table 1 was determined. In the event of differences between researchers in the number of errors recorded for a text, the text was reviewed again with both researchers present to reach agreement. As guides, Carwadine (2000) and Hoelzel (2002) were consulted. If evidence to support an error was contradictory from different sources, no error was recorded.

The frequency of species represented in fictional and non-fictional texts was compared according to Preacher (2001). Minitab 14.12 was used to perform Mann–Whitney U testing to compare errors between the fictional and non-fictional texts.

Results

A total of 116 children's English language picture books, suitable for children aged 8 years and younger, including at least one image of a cetacean was located (Online Appendix 1). Of the total, 55 were considered to be fictional and 61 non-fictional texts.

The fictional books contained representations of 23 species of cetaceans while the non-fictional books contained 29 species. The most commonly depicted species in the texts examined were humpback whales (appearing in 35 texts), blue whales (appearing in 33 texts) and killer whales (appearing in 31 texts) (Fig. 1). No significant difference was observed between the proportions of observations of each species in fictional and non-fictional books (X^2 (9, N = 229) = 12.31, p = 0.196, testing was performed on the overall 10 most commonly observed species). Representations of cetaceans in fictional books were significantly more likely to be assigned to the general categories ("general toothed whale", "general baleen whale", "general whale") than to be assigned to the species level, when compared to representations in non-fictional books (X^2 (1, N = 317) = 16.06, p < 0.01).

A total of 580 errors was identified in the 116 books examined (mean = 5.0 errors/book, SD = 8.8). The fictional books examined contained 438 errors (mean = 8.0 errors/book, SD = 11.1), while the non-fictional books examined contained 142 errors (mean = 2.3 errors/book, SD = 4.9). Of the fictional texts, 44 (80.0%) were found to have errors in one or more of the categories, and 29 (52.7%) were found to have errors in three or more of the categories outlined in Table 1. Of the non-fictional texts, 30 (49.2%) were found to have errors in one or more of the categories, and 10 (16.4%) were found to have errors in three or more of the categories (Fig. 2).

The category in which errors were most frequently observed was the number of blow holes, with 34 (61.8%) of fictional texts and 17 (27.9%) of non-fictional texts displaying errors in this category (Table 1). Fictional texts were found to contain errors in significantly more categories than non-fictional texts (U = 877.5, Z = −4.4205, p < 0.05).

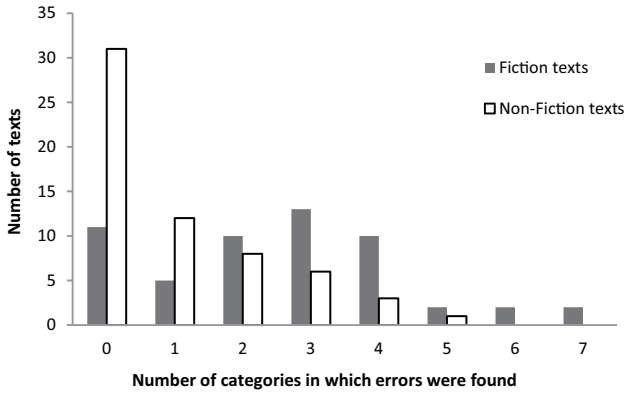

Fig. 2 Number of categories errors were detected in for each text examined. Total number of texts examined was 116, of which 55 were fictional and 61 were non-fictional texts. The nine error categories are described in Table 1

Discussion

Currently 90 species of cetacean are recognised (IUCN Cetacean Specialist Group 2015), the fictional books in this study therefore mentioned 25.6% of cetaceans and non-fictional books mentioned 32.2%. In UK waters, 28 species of cetacean have been recorded (Reid et al. 2003) including rare sightings of the two species most encountered in the children's books (humpback whale and blue whale). Of the 11 cetaceans species that are regularly seen throughout the year in UK waters (Reid et al. 2003), Atlantic white-sided dolphin (*Lagenorhynchus acutus*) and white beaked dolphin (*L. albirostris*) were not encountered in any of the 116 texts examined. Genovart et al. (2013) found that children had more knowledge of exotic species than local ones even when local fauna is of similar or greater conservation concern, and warned that this may lead children to associate wildlife and its conservation with exotic species. As the search for books in this study was carried out in the UK, greater representation in the literature of cetacean species regularly found in UK waters may be beneficial in fostering understanding of local ecosystems.

Of the 116 picture books examined in this study, 74 (63.8%) had errors in the representation of cetaceans in the images and/or text. It has been argued that children should be encouraged to read any text that interests them and that there is no such a thing as a bad book for children (Gaiman 2015). Children's picture books can be evaluated on many levels such as the quality of illustrations, the successful blend of images with text, and the popularity with children themselves, the latter being a key factor in developing a love of books that children can take with them into adulthood. Clearly, literacy is of key importance, and it has long been recognised that children who read more develop better reading skills than those who read less (Juel 1988). Encouraging children to read texts that interest them is more likely to lead to more reading than encouraging texts that children do not find interesting. Developing literacy is important in developing citizens of the future who are sufficiently informed to engage in environmentally responsible behaviour. However, children are collecting information about the world around them from all available sources and typically before the age of eight cannot make clear distinctions between reality and fantasy (Wells and Zeece 2007). The argument that biological content of children's books is unimportant if the book is not solely focussed on biology is in some ways like suggesting that the spelling or punctuation is unimportant in a science book as it is not focussed on teaching English.

This study found significantly more errors in fictional than in non-fictional texts. This result mirrors that of the study of Tundle et al. (2008) looking at representations of the moon in children's literature and strengthens the caution that the classification of nonfiction does not guarantee the factual accuracy of content. Neuman and Roskos (2012) report a shift towards using a greater proportion of information text within the elementary curriculum resulting in children being exposed to more technical vocabulary and making reading more lexically challenging for young readers. However, the focus of such texts is not only learning-to-read, and the fact that errors are found with such frequency in non-fictional texts undermines the goal of reading-to-learn.

While the errors in nonfictional texts are particularly worrying for children from the age of 8 as they have developed the ability to unequivocally make distinctions between reality and fantasy (Wells and Zeece 2007), the shift towards using more nonfiction in the curriculum will expose children to less errors. Neuman and Roskos (2012) point out that the shift towards the information genre fails to recognise that many storybooks contain a great deal of information, using the classic example of *The Very Hungry Caterpillar* (Carle 1969) as an example. Fictional books can have a particular draw to young children, with favourite stories requested repeatedly and this multiple exposure has been shown to be beneficial in terms of positive effects on the expressive language, story-related vocabulary and the story comprehension of young children (Trivette et al. 2012). This is also, however, potentially multiple exposure to biological errors. Small changes to the text or images in fictional books to make them biologically accurate, for example the hungry caterpillar changing into a butterfly with the correct number of wings (four), would have minimal impact on the story but would result in multiple exposure of children to factual information that could contribute to their understanding of the natural world.

The errors identified in fictional books could be interpreted as artistic or poetic licence. Oliveira (2015) comments that fictional writers cannot be accused of misleading their audience as they have no commitment to factuality. However, this study has not recorded an error when cetaceans are

given a voice, or when they communicate with other species in English, both common narrative styles in children's fiction. The errors recorded have been limited to biological fact. Children's imagination is important in thinking, logic and communication as well as in developing coping skills (Smith and Mathur 2009), but it is of questionable value for children to imagine that a fish-eating animal is a herbivore or that a dolphin has no blowhole, especially when this may be influencing their biological understanding. In a review of how dolphins are portrayed in literature, film, television and music, Fraser et al. (2006) concluded that the concept that dolphins desire and require human care seems to be being reinforced. The findings of this study support the conclusion of Fraser et al. (2006) with 16 texts (13.8%) identified with errors in the representation of interactions between cetaceans and other species. Kubiatko and Prokop (2007) found that only a third of 468 school children (aged 10–15) knew that dolphins breathed with lungs. Errors in the natures of the blow were identified in 23 texts (19.8%) in this study suggesting a reason behind this lack of knowledge, and suggesting the same lack of knowledge exists in some of those involved in producing children's literature. Allen (2015) reported a decrease in performance in the ability of children to correctly classify animals between the ages of 3 and 5 years and attributed the result to the older children using more abstract criteria that were taxonomically inappropriate. The additional 2 years of exposure to biological errors in picture books in the older age group may also have contributed to the decline in performance in classification that Allen (2015) reports.

Given that minimal effort would have been required to avoid the kind of errors encountered in this study (e.g. locating a photograph of the species, consulting a dictionary, viewing the web page of a research group) it can be questioned why such errors are found at all in an era where the Internet has allowed even specialised information to become accessible to the general public, or at least interested laypersons (Schiele 2015) which would hopefully include authors of books for children. Sackes et al. (2009) suggest that oversimplication of science content and limited scientific background of authors can be a source of errors in children's literature. Tundle et al. (2008) point out that the author and illustrator frequently work in independent roles in the publication world of children's literature meaning that the author is generally given little input in the artistic process. Both author and illustrator may have a lack of appreciation of the potential of their work to have a positive impact on understanding of the marine environment, which has been found to have a significant positive correlation with interest and value placed on the ocean (Guest et al. 2015), and caring enough is critical in wanting to help solve environmental problems (Williams et al. 2012).

Suggestions that can be made viewing the results of this study include encouraging the use of fictional texts to challenge students to identify improvements to increase biological accuracy. On encountering an error in the text or images in a book, children can be asked to compare this to real-life experience, or to photographs or film clips of the organism. Kwen (2005) identifies misconceptions concerning key biological science concepts among teachers, so it would be important to improve primary teacher science education accordingly to create a level of subject confidence in teachers to support students challenging the information to which they are exposed. Schussler (2008) comments that since teachers lack content knowledge, it is important that scientists and educators screen children's books and make the information about content available to teachers. While such information could certainly be useful to teachers, there would be practical problems in scientists being able to offer information about all the errors and misconceptions contained in children's books. Should a similarly large proportion of children's books contain spelling errors, it is unlikely that turning to English language scholars post-publication would be suggested above fixing the problem at the pre-publication level. Authors and illustrators need to be more strongly encouraged to pay attention to providing accurate information in their books. As Rice (2002) notes, teachers do not always take, or indeed have, time to consider the scientific accuracy of the content of books they use in the classroom, thus providing teachers with a wide range of factually accurate non-fiction texts to work with would be a positive platform to build from. Encouraging improved links between author and illustrator could remove errors from texts as could publishers being encouraged to seek the opinion of the scientific community. Greater links with scientific researchers would improve the accuracy of nonfictional texts and, as is being recognised by the film and television industries (Cohen 2008), such links may also vastly improve fictional works.

Books are only part of the picture. Spending time in wild places and many other types of indirect exposure including television, films and internet sites are possible sources from which children are assimilating biological information. Of all indirect sources, it could be argued that picture books have a unique place in fostering through interaction the kind of wonder in the natural world that is required for the future of our planet, particularly for young children not yet with the reading fluency to tackle the texts alone. As picture books themselves have been found to be increasingly set in built environments (Williams et al. 2012), there is increased importance that stories set in the natural world reflect a biological reality that many children are not experience in other ways.

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