





Considering connections between Hollywood and biodiversity conservation

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Abstract: *Cinema offers a substantial opportunity to share messages with a wide audience. However, there is little research or evidence about the potential benefits and risks of cinema for conservation. Given their global reach, cinematic representations could be important in raising awareness of conservation issues and species of concern, as well as encouraging greater audience engagement due to their heightened emotional impact on viewers. Yet there are also risks associated with increased exposure, including heightened visitor pressure to environmentally sensitive areas or changes to consumer demand for endangered species. Conservationists can better understand and engage with the film industry by studying the impact of movies on audience awareness and behavior, identifying measurable impacts on conservation outcomes, and engaging directly with the movie industry, for example, in an advisory capacity. This improved understanding and engagement can harness the industry's potential to enhance the positive impacts of movies featuring species, sites, and issues of conservation concern and to mitigate any negative effects. A robust evidence base for evaluating and planning these engagements, and for informing related policy and management decisions, needs to be built.*

Keywords: CITES, consumer research, Google trends analysis, impact evaluation, industry engagement, nature deficit disorder, social media, wildlife trade

La Consideración de las Conexiones entre Hollywood y la Conservación de la Biodiversidad

Resumen: *El cine ofrece una oportunidad sustancial para compartir mensajes con un público amplio. Sin embargo, hay pocas investigaciones o evidencias sobre los beneficios potenciales y los riesgos del cine para la conservación. Dado su alcance global, las representaciones cinematográficas podrían ser importantes para crear conciencia sobre los temas de conservación y las especies de importancia, así como alentar un mayor compromiso del público debido a su alto impacto emocional sobre los espectadores. Aunque también existen riesgos asociados con la exposición incrementada, incluyendo una mayor presión de visitantes a las áreas sensibles ambientalmente o cambios en la demanda de los consumidores por especies en peligro. Los conservacionistas pueden entender y comprometerse mejor con la industria del cine estudiando el impacto de las películas sobre la conciencia y comportamiento del público, identificando los impactos medibles sobre los resultados de la conservación, y colaborando directamente con la industria filmica, por ejemplo, en una capacidad de asesor. Este entendimiento y compromiso mejorado puede aprovechar el potencial de la industria para aumentar los impactos positivos de las películas que incluyen especies, sitios y temas de importancia para la conservación y para mitigar cualquier efecto negativo. Se necesita construir una base sólida de evidencias para evaluar y planear estos compromisos y para informar las políticas relacionadas y las decisiones de manejo.*

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Palabras Clave: análisis de tendencias en Google, CITES, compromiso de las industrias, desorden del déficit de la naturaleza, evaluación de impacto, investigación sobre el consumidor, medios sociales, mercado de fauna

摘要: 好莱坞与生物多样性保护的联系

电影提供了许多与广大观众分享信息的机会。然而,关于电影对于保护的潜在益处和风险的研究或证据却寥寥无几。考虑到电影在全球范围内的影响力及其对观众的情感强烈的影响力,影像的呈现在帮助人们更好地认识保护问题和受关注的物种、鼓励更多的大众参与到保护中可以起到重要的作用。然而,增加物种的曝光度也存在风险,包括加重环境敏感地区的游客压力,或改变消费者对濒危物种的需求。通过研究电影对观众意识和行为的影响,可确定电影对保护效果可定量的影响,并直接参与到电影行业中。例如,担任电影顾问,保护工作者可以更好地理解和参与电影行业。而更多的理解和参与将有助于充分发挥电影行业的潜力,来提高以物种、地点和保护问题为特色的电影的积极作用,同时减轻负面影响。最后,还需要建立一个强有力的以证据为基础的方法来评估和规划对电影行业的参与,并为相关政策和管理决定提供信息。【翻译:胡怡思;审校:魏辅文】

关键词: 濒危野生动植物种国际贸易公约 (CITES), 消费者调查, 谷歌趋势分析, 影响评估, 行业参与, 大自然缺失症, 社交媒体, 野生动物贸易

Introduction

Watching Disney's new version of *The Jungle Book* (2016) inspired us to write this article. As a growing percentage of the world's population becomes concentrated in urban areas (Wigginton et al. 2016), citizens of postindustrial nations increasingly report a sense of disconnection from the natural world (Miller 2005). Meanwhile, human ability to simulate the wild has increased dramatically. The new *Jungle Book* features a spectacular depiction of a South Asian jungle and its inhabitants, created mostly by computer generated imagery (CGI), that viewers can experience from the comfort of their chairs. The movie highlights the plight of pangolins (*Manidae* spp.) through humor, and the pangolin-character merchandise has been used to promote their conservation (Flocken 2016).

Visual media (Vivanco 2002; Sandbrook et al. 2015) and arts (Curtis et al. 2014; Verma et al. 2015) are becoming increasingly important channels, filters, and mirrors of human understanding about the natural world. Their linkages to environmental engagement, attitudes, norms, policy support, and, ultimately, human behavior—key considerations of conservation concern worldwide (St John et al. 2013)—must therefore be examined. On the one hand, evocative footage of natural spaces and rare or charismatic species may increase media consumers' interest in and support for biodiversity conservation. For example, exposure to visual depictions of charismatic flagship species is associated with people's concern for that species and conservation intentions (Smith & Sutton 2008). On the other hand, spectacular imagery could create or reinforce simplified, romantic ideals of nature and wildlife that some might adopt as a comfortable substitute for challenging real-world encounters. Furthermore, watching wildlife on screen may not translate into conservation action, given the often limited or unclear effectiveness of environmental education as a single tool for effective behavior change (Holmes 2003). At worst, increased exposure could produce new, unforeseen threats

to species and locations thrown into the spotlight by their starring role in a blockbuster. As a result, it is important for conservation scientists to identify the opportunities provided by visual media for achieving conservation goals (Knight & Cowling 2007) and to invest in anticipating the potential consequences of engaging with associated industries (Cook et al. 2014).

Although nature documentaries may serve as sources of information about wildlife and conservation issues (Dingwall & Aldridge 2006), they often target audiences with an existing interest in the topic. Movies, in contrast, may not offer the most direct way to highlight a specific conservation issue but may reach larger, broader audiences. Documentaries are normally distributed via television, which makes viewing figures difficult to compare with cinema releases. However, perhaps the most successful cinema-format wildlife film, *March of the Penguins* (2005), had a lifetime box-office revenue of \$77,437,223, whereas the animated, animal-focused movie *Madagascar* (2005) had revenues of \$193,595,521 in the same year (Box Office Mojo 2016). Cinema is generally considered a more immersive format and lends itself well to spectacular sound, imagery, and action sequences. It might therefore have greater emotional impacts on audiences than television (Visch et al. 2010; Baranowski & Hecht 2014). There is considerable variation in how the movie industry could influence conservation impacts. Films vary in their presentation of conservation issues, from those with obvious environmental motives (including many examples discussed below), to those with no conservation message that may nevertheless influence behavior. Our question, then, is, What role does, or could, Hollywood play in conservation?

Despite the long-standing tradition of the movie industry producing wildlife-focused content (e.g., the Oscar-winning *Serengeti Shall Not Die* by Bernhard and Michael Grzimeks [1957] and Disney's *Bambi* [1942]), surprisingly little attention has been given to critically reviewing its potential impacts (Jepson et al. 2011). Impacts, here, may be positive or negative and may affect audiences

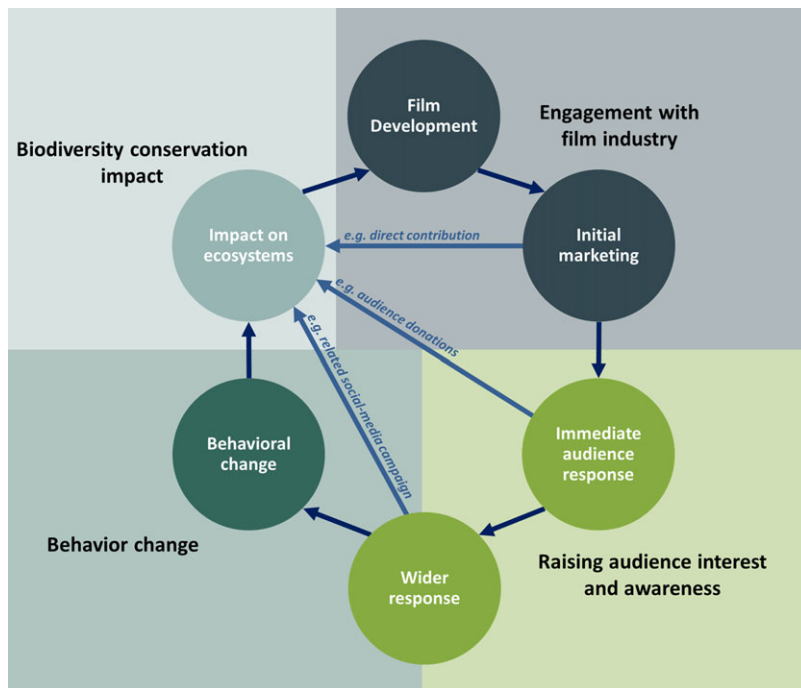


Figure 1. A framework for understanding the influence of cinema on biodiversity conservation, from initial engagement with the industry, to effects on audience awareness, to behavior change and conservation outcomes. This framework is iterative and conservation outcomes can be used to inform future engagements with the industry. Central lines (with examples) indicate potential direct routes to conservation impact from earlier stages in the process.

(e.g., knowledge, perceptions, and behavior); socioeconomic trends (e.g., increasing demand for a pet, visits to a location, or resource allocation to an issue); and, ultimately, conservation outcomes (e.g., habitat protection or disturbance, species recovery or decline). We considered some of the opportunities and challenges movie fame can create for conservation. Although we recognize the presence and potential importance of international movie industries and independent filmmaking, we primarily refer to mass-market productions of the American movie industry (aka Hollywood), which continue to attract the highest level of investment and dominate global box office receipts. However, much of our discussion also applies to movies made elsewhere and on smaller budgets and to other visual media targeted at general audiences (e.g., YouTube, TV shows, etc.). We outline a range of methodological approaches, including both qualitative and quantitative techniques, to consider how the impact of silver-screen appearances might be assessed and monitored and provide a framework to guide future research (Fig. 1 & Table 1), encourage engagement with the industry, and inform policy decisions. We argue that better understanding of the impacts of Hollywood on conservation can only be beneficial and may enable the harnessing or mitigation of these impacts as conservation tools.

Opportunities

Movies provide a potent means of sharing biodiverse landscapes, wildlife spectacles, and exotic or rare species

with a wide audience. The extent to which awareness affects proconservation attitudes and behaviors is often complex and unclear, given the myriad other factors at play (Howell 2014; Moorhouse et al. 2017), but there is a clear role for cinema in introducing audiences to new places, species, and conservation problems. To date this has most frequently been achieved through animated features that do not require rare wildlife or inhospitable environments to be found or filmed (Yong et al. 2011), but continuing advances in CGI and motion-capture technologies may change this. Specific reference to the conservation status of the taxa involved may be important for raising the profile of particular species (but see Colléony et al. [2017]). Blue Sky Studios' *Rio* (2011), for example, features the critically endangered Spix's Macaw (*Cyanopsitta spixii*), and several plot points involve conservation issues, including the illegal trade in exotic birds and captive breeding of threatened species. Although a positive conservation outcome for this species may be unrealistic, the issues highlighted affect many tropical parrots.

A second, subtler, example is the inclusion of a pangolin (*Manidae* spp.) in Disney's remake of *The Jungle Book* (2016). It makes a cameo appearance, spectating while Mowgli, the protagonist, retrieves honey from a tall cliff. Fellow observer Baloo (a sloth bear [*Melursus ursinus*]) threatens the pangolin with the line "You have never been a more endangered species than you are at this moment," a knowing comedic reference to the precarious real-world status of pangolins in southern and eastern Asia. All 4 Asian species are threatened by hunting and illegal trade, listed as endangered or critically endangered on the IUCN Red List, and listed by the Convention

Table 1. The potential positive and negative impacts of cinema on biodiversity conservation and suggested research questions and methods to investigate them, from the raising of audience awareness, to direct conservation impact, to increased industry engagement.

<i>Potential contribution</i>	<i>Opportunities</i>	<i>Risks</i>	<i>Suggested research questions</i>	<i>Example research approaches</i>
Engagement with film industry	Collaborations between filmmakers and conservation organizations Coproducting of movie content with conservation messages	Primary interests of movie industry are commercial, which may produce conflicts of interest.	What environmental awareness is there within the industry? What common gains could industry and conservation work toward? How can positive relationships between the movie industry and conservation community be fostered?	Social research into industry engagements with conservation (e.g., interviews, focus groups, expert shadowing) Socioeconomic research into audience interests and market trends
Raising audience interest and awareness	Disseminating information about conservation issues among wider audiences Increasing interest in species, ecosystems, issues of conservation concern	Sensationalist or romanticized representations could be problematic if they alter audience perception of the species and people involved. Uneven societal interest in certain species and ecosystems may be reinforced.	How are different types of messaging around conservation understood and interpreted? What movie characteristics are more effective at increasing public environmental awareness and interest?	Google trends analyses (e.g., species or site searches) Audience surveys (e.g., evaluating environmental awareness and intention to support specific conservation intervention) and experimental viewings Discourse and content analyses
Behavior change	Increased public, political, and financial support for conservation Beneficial changes in consumer and sociocultural practices (e.g., reduced market demand for threatened species or products; increase in proconservation behaviors)	Visitor pressure and development at vulnerable sites may increase. Market demand for threatened species (or products) may increase.	Is the film a catalyst for change or part of a gradual shift? What movie characteristics, if any, are more effective at producing behavioral change? What type of behavioral changes can effectively be attributed to films?	Correlation of behavioral change to movie release dates and peak screening and audience demographics (e.g., charitable contributions, visitor numbers, market trends) Longitudinal audience surveys based on self-reported behaviors Direct approaches to measuring behavior change (where possible)
Biodiversity conservation impact	Identifiable contribution to conservation of species or sites (e.g., increased wildlife abundance or reduced habitat loss) Measurable reduction in behavior of conservation concern (e.g., trade of threatened species or products)	Loss or degradation of vulnerable species or sites may increase. Trade in threatened species or products may increase.	Are biodiversity conservation outcomes correlated to movie releases? Is there evidence of causality? If so, what is the nature of the impact?	Trend analysis of changes in species or site condition or CITES data in relation to film release date and peak screening or popularity of a movie Mixed-methods case studies, ideally initiated prior to movie release and monitoring reception and impact

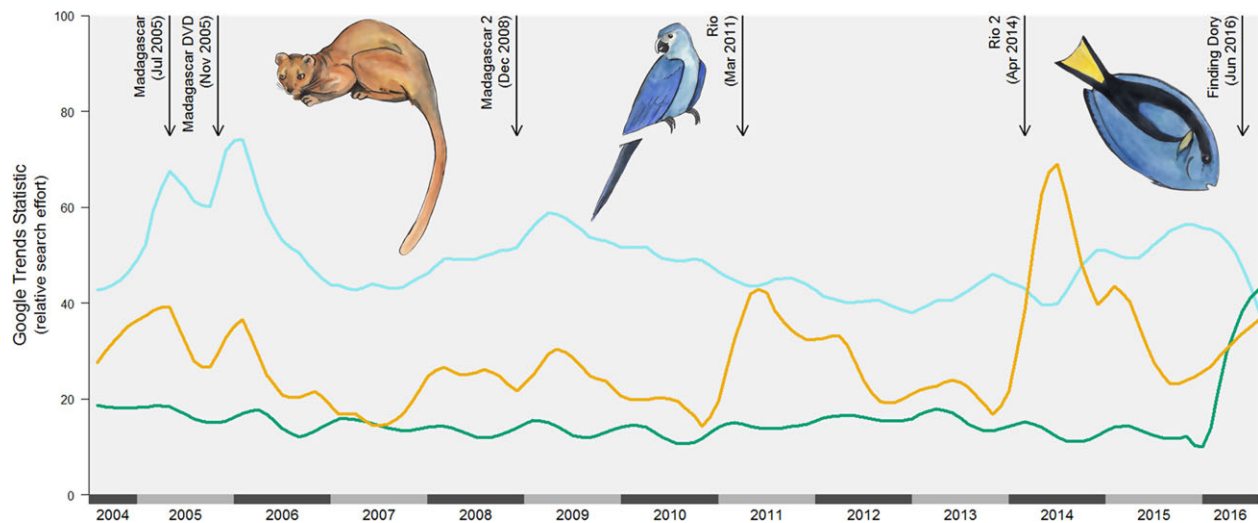


Figure 2. Google Trends statistics for searches in the United States for fossa (*Cryptoprocta ferox*), Spix's Macaw (*Cyanopsitta spixii*), and blue tang (*Paracanthurus hepatus*) featured in animated films (respectively, *Madagascar* [blue], *Rio* [orange], and *Finding Dory* [green]) relative to movie release times. Lines are smoothed with local polynomial regression fitting (details and R code in Supporting Information).

on International Trade in Endangered Species (CITES) (Challender et al. 2014). *The Jungle Book* director Jon Favreau has since revealed that Los Angeles zoo staff (acting as advisors to the filmmakers) had suggested the pangolin's inclusion (Flocken 2016). Favreau had previously been unaware of pangolins but became an advocate of featuring the species and encouraged Disney to add a pangolin to their merchandise lineup as "a commitment to raise awareness for the pangolin and the overall efforts of the Disney Conservation Fund" (Flocken 2016). Even without a direct conservation message, featuring relatively little-known species can inspire public interest. The appearance of fossas (*Cryptoprocta ferox*) in Dreamworks' animated film *Madagascar* (2005), for example, led to a substantial increase in U.S. Google.com searches for *fossa* (Fig. 2).

Cinema also has the potential to substantially increase awareness of a featured area or region. The release of *Wild* (2014), based on author Cheryl Strayed's 2009 solo hike along the Pacific Crest Trail (USA) (a route mostly through National Forest and protected wilderness) prompted a dramatic increase in footfall on the trail. The number of permits issued for hikes of >500 miles increased by 70% between 2014 and 2015 (Pacific Crest Trail Association 2014, 2015). The Pacific Coast Trail Association encourages fans of *Wild* to become members, thereby contributing to the upkeep and conservation of the scenic trail (<http://www.pcta.org/wild>). In conjunction with effective management, therefore, visitor increases to areas such as this could have positive outcomes by inspiring concern for—and investment in—their conservation.

A further potential advantage is the heightened emotional impact that movies can carry (Visch et al. 2010).

Again, this is often associated with the use of non-human characters in animated or effects-driven films. *Happy Feet* (2006), for example, carries strong messages about overfishing and plastic pollution: in one scene Lovelace, a Rockhopper Penguin (*Eudyptes* spp.), becomes entangled in six-pack plastic rings. Movies' ability to portray conservation problems through the eyes of well-developed, sympathetic (albeit often anthropomorphic) animal characters could make the inclusion of such scenes an especially powerful tool. Negative conservation messages can be associated with feelings of guilt or powerlessness, emotions that animated films may not be seeking to inspire. However, optimistic messages—a better fit with animated movies—may also be more successful in achieving support and lasting behavior change (Garnett & Lindenmayer 2011). From the earliest Disney movies to more recent animated and CGI productions, animals and the natural world are common themes of films targeting younger audiences, who will be actors in future social change and on whom there may be greater emotional and long-term effects (Gifford & Nilsson 2014). An excellent illustration is the "Bambi effect" (Hastings 1996), the impact that the emotive loss of the titular character's mother in Disney's 1942 film is believed to have had on audiences' attitudes toward hunting.

Director James Cameron intentionally sought emotional impact from his environmental fable *Avatar* (2009): "I just want [people] to internalize a sense of respect and a sense of taking responsibility for the stewardship of the earth . . . I think the film can do that by creating an emotional reaction" (quoted in Erbe 2011). *Avatar* has a more general environmental message that nevertheless touches on specific conservation issues,

including natural resource extraction, maintaining ecosystem function, and habitat loss. Similarly, movies set in the midst or aftermath of environmental disasters can explore broader environmental issues through visions of a world devastated by climate change or food and energy crises. Recent examples include *The Road* (2009), *Interstellar* (2014), and the recently reinvigorated *Mad Max* franchise.

Risks

Conservation is not, of course, the primary aim of the modern movie industry, and there are also potential negative impacts of silver-screen appearances for featured species, habitats, and landscapes. The global reach and influence of Hollywood movies enable them to ignite market trends, with challenging implications for conservation. An often-repeated example is the purported impact, on wild clownfish populations, of increased market demand for common clownfish (*Amphiprion ocellaris*) associated with the release of Disney-Pixar film *Finding Nemo* (2003) (Strange 2008; Yong et al. 2011; Bush et al. 2014). This is despite the film's plot that implies wild-caught tropical fish make unsuitable pets: Nemo's abduction from the reef and subsequent imprisonment in a dentist surgery's tank is key to the storyline. The example suggests that increased interest in a species might drive market demand for its consumption or trade and indicates that a movie's key messages may not be received or interpreted as expected. Nevertheless, to our knowledge, evidence of a Nemo effect is scarce, and data that support assertions about the direct impacts of cinema are generally limited (Strange 2008). This therefore represents a prime example of why research investigating the type, magnitude, and direction of any impacts is required. For example, analyses of the spatial and temporal distribution of illegal trade incidents could be related to movie release dates to determine how they may have influenced the market.

A further potential issue is how particular species or people are portrayed. Contemporary cinema acts as both a reflection and propagator of villainous stereotypes, and repeated negative portrayals of particular species and peoples in popular culture can have long-lasting impacts on their public image. For example, although difficult to quantify, *Jaws* (1975) is strongly implicated as responsible for an increased awareness of sharks in the Western psyche, one often accompanied by an exaggerated perception of the risks they pose, with likely consequences for their conservation (Neff 2015; Nosal et al. 2016). Stories behind human characters and cultures also risk being oversimplified, belying the real-world complexity of people's use of, and dependency on, natural resources (e.g., Knapp et al. 2017).

Positive and romanticized depictions of wildlife can also have inadvertent conservation impacts. The *Bambi* effect is unlikely to be solely or even primarily responsible for antihunting sentiments; rather, it may be indicative of broader shifts in cultural attitudes toward wildlife in the mid-20th century (Hastings 1996). Nevertheless, the movie popularizes and reinforces a narrative of separation between humans and wildlife and promotes an ethic of nonintervention. This hands-off attitude may affect the ability of wildlife managers to kill deer, for example, irrespective of the effects large deer populations can have on other species and forest regeneration (Chollet & Martin 2013).

Another complex and contradictory story that characterizes the diversity and extent of cinema's impacts on conservation is Warner Bros' *Free Willy* (1993), in which a captive orca (*Orcinus orca*) is returned to the wild with the help of a dedicated young boy. In the famous climactic scene, the whale leaps to freedom over a harbor wall. The movie's impact continues to resonate more than 20 years later, but it is multifaceted. First, *Free Willy's* positive depiction of previously maligned killer whales has been credited with an about-turn in how this species is perceived by Western publics. Compare the gentle character of Willy with the dangerous, revenge-seeking creature in *Jaws*-inspired *Orca* (1977) (Lawrence & Phillips 2004). Second, the film inspired a popular campaign to free Keiko, the whale starring as Willy. Keiko became the poster-child of captive orcas and millions of dollars were poured into his rehabilitation and eventual release (though he died less than a year later) (Grimm 2016). The ethics of exhibiting captive orcas, ostensibly to represent and enable the conservation of their wild cousins, remain hotly disputed and served as the topic of the provocative and influential documentary *Blackfish* (2014). Third, *Free Willy* probably contributed to larger changes in cultural attitudes to whales that created the conditions for a commercial whale-watching industry (which has both positive and negative implications for conservation [Lawrence & Phillips 2004; Wearing et al. 2011]). This case highlights the power of an animal movie star to raise the profile of both species and individual animals (like Keiko) and the challenges created by the translation of complex, real-world conservation issues into neat, romantic Hollywood spectacles.

Cinema exposure can also have major implications for a featured region or ecosystem. Rapid changes in visitor pressure and behavior can result from increased public awareness and media attention associated with movie appearances (Beeton 2016), a phenomenon known as film-induced tourism that is sometimes incidental but can be orchestrated. For example, *Australia* (2008) was publicized in collaboration with the country's tourist board. From a conservation perspective, this could create problems if increases in visitor pressure are overwhelming or ecosystems are not resilient (Sakellari 2014).

Furthermore, if not managed appropriately, increased tourism can have problematic socioeconomic consequences, illustrating the need to consider a wide range of potential impacts. In the detailed example outlined by Cohen (2005) pertaining to *The Beach* (2000), modifications made by the filmmakers to a little-used beach in a Thai national park led to division between local business owners and challenges to democratic procedure, as well as environmental concerns.

Films with explicit environmental messages or subtexts may be perceived as depressing or sanctimonious, potentially limiting their effectiveness (and, indeed, their popularity because a visit to the cinema may be seen as an opportunity to escape the world's problems). Sensationalized depictions of environmental issues can also obfuscate or misrepresent real problems. Notably, the disaster movie *The Day After Tomorrow* (2004) ignited media debates about climate change, but it was also known for its scientific inaccuracy (Leiserowitz 2004).

Assessing the Impact of Films

We have discussed some key opportunities and challenges the movie industry presents for biodiversity conservation that have clear implications for policy and management decision making. However, the current lack of evidence surrounding most of these suppositions undermines the ability to effectively harness cinema as a conservation tool or adequately mitigate any negative impacts (Fig. 1). Consequently, assessing and monitoring public responses to movie appearances of species, systems, and spaces of conservation concern will be imperative for understanding the impacts of Hollywood on conservation. This will require a cross-disciplinary approach. We have outlined some of the qualitative and quantitative approaches that could be used as part of a research framework to assess and understand these impacts (Table 1).

Audience Responses

Engagement with cinema-going audiences will be important in investigating a movie's immediate effect on viewers. A range of qualitative and quantitative social research methods (such as questionnaire surveys, interviews, and discussion groups) could be used to monitor increased interest or awareness in conservation issues following their appearance in a movie; the kind of messages communicated; and whether these messages are likely to lead to further action or behavioral change. This has been studied previously through questionnaires that assess intention to act. For example, research surveying moviegoers before or after watching *The Day After Tomorrow* showed that participants sampled after viewing were willing to allocate approximately 50% more in monetary donations to climate mitigation, when choosing among

5 good causes, than those questioned before (Balmford et al. 2004). However, they were no more likely to plan on taking emission-reducing actions. Other researchers have considered the effects of movies and documentaries on public perception of and attitudes toward climate change and science by surveying moviegoers before and after watching. The methods used included survey groups and questionnaires (Lowe et al. 2006), as well as investigations of long-term impacts on perception (Reusswig & Leiserowitz 2005; Howell 2011).

A similar approach could be applied to investigating awareness of more specific conservation issues and corresponding behavioral change. If possible, studies should address broader changes in attitude or find a way of directly measuring behavior change in addition to assessing the intention to act, because responses to this method alone are susceptible to social desirability biases (Chao & Lam 2011). Comparative or experimental approaches could also be used to assess responses to different films and potentially identify which aspects of movie appearances influence viewers and how. Responses might be affected, for instance, by the realism of a setting (Schroepfer et al. 2011) or the soundtrack (Nosal et al. 2016).

Monitoring Online Responses

Increasingly, it may be possible to monitor audience responses by looking to their online activity, the advantages and disadvantages of which are discussed by Arts et al. (2015). Recognizing that human actions are increasingly played out in a digital realm, Roll et al. (2016) used page views of the Wikipedia online digital text archive as a metric of global interest in reptiles. Google trends statistics have also been used in relation to conservation (Proulx et al. 2014), for example, to explore factors influencing internet saliency of bird species (Correia et al. 2016). One can download Google trends data directly or perform and display queries with the R package *gtrendsR* (Massicotte & Eddelbuettel 2016). As an example, we examined the cinematic impact of 5 films with Google trends statistics (Fig. 2). The Google searches used were in the following categories: fossa, animal; blue tang, search term; and Spix's Macaw, organism classification. Data were extracted directly from the Google trends information online. The Google trends statistic represents relative search effort (the period of maximum search effort has a value of 100). We found the release of the *Madagascar* (2005 and 2008) and *Rio* (2011 and 2014) films and *Finding Dory* (2016) corresponded to spikes in searches for focal species featured in each movie. A second small peak in searches for *fossa* is related to the release of *Madagascar 2*, despite the fact that the film did not include this character (these additional searches likely represent an increase in people watching the original movie). Google trends indicate interest in a specific attribute, without

considering whether this is positive or negative for the species or ecosystem concerned. Further research is needed to understand the type of interest a film has elicited before drawing a link to possible conservation outcomes (Table 1 & Fig. 1). Search terms could subsequently be refined to explore the depth or geographic localization of increased interest in an issue and could help target subsequent efforts to capitalize on increases in salience or mitigate potential problems.

Media, Discourse, and Case Analyses

Beyond the initial impact of movies on their audiences, researchers should also examine the secondary response (i.e., influence on wider public discourses) and longer-term effects. Digital technology now plays a vital role in promoting both conservation and movies (Arts et al. 2015), and how movie messages are propagated and reported by news and social media will affect the power and longevity of their influence. The use of media content and discourse analyses could be especially powerful in teasing apart responses across multiple platforms, and semilongitudinal case studies of movie impacts and legacies could also reveal important insights (e.g., *Free Willy* and *The Beach*).

Industry-Based Research

Researchers should investigate the aims and motives of filmmakers, studios, and others involved in producing movies featuring certain species, environments, or conservation problems. This might involve, for example, interviews, focus groups, or ethnographic research, with writers, producers, and scientific advisors involved in developing conservation-relevant stories. Direct engagement will be central to developing an understanding of the movie industry and how to work effectively within it: fostering cinema-conservation relationships; clarifying aims and objectives with filmmakers; and identifying potential areas of engagement or collaboration. Assessing the engagement of potential stakeholders is an effective method in conservation planning (Raymond & Knight 2013).

Biodiversity Impacts

If conservationists aim to explore the potential role of movies in promoting positive conservation and environmental behaviors (e.g., enhance financial support for specific conservation projects or decrease demand for illegally traded species), ultimate effects must also be considered. If a specific ecosystem or species is portrayed in a movie, indicators of conservation status, such as abundance trends, could be explored, taking into account peak cinema-screening and home-release periods. However, given the time and spatial scales at which these processes can occur, the time lags between interven-

tion (e.g., movie release) and measurement of indicator trends and the potential difficulty in directly attributing any changes that occur to single factors, other indicators may be essential for assessing biodiversity impacts. The records from CITES (Challender et al. 2015) could be used to investigate changes in trade for some species, while in other situations market surveys (Harris et al. 2015) and online media (Hinsley et al. 2016) could be monitored to better assess demand for goods of conservation concern (although this will not be possible for all species). These will also provide key information on wildlife consumers and how media influences them, ultimately providing insights about how to mitigate potential negative impacts.

Harnessing the Power of Hollywood

Andrew Stanton, writer and director of *Wall-E* (2008)—in which the last robot on Earth cleans up the detritus of long-departed humans—said: “I don’t have an ecological message to push. [But] I don’t mind that it supports that kind of view” (Simon 2008). Although in this instance the environmental message was incidental to the story, movies might nevertheless be purposefully employed by conservationists to highlight issues of concern; brand placement is already common in big-budget movies. Productions that feature wildlife or naturalistic settings often employ scientific advisors who may have, or could form, links with interested organizations. There are therefore at least two established frameworks within which conservationists might engage with the industry (Cook et al. 2013).

The impact of movie references to a conservation issue could be enhanced by providing additional information and highlighting relevant campaigns and organizations in the credits and associated promotional materials (Arendt & Matthes 2014), and this may provide an excellent starting point for conservationists to engage with other forms of visual media (e.g., YouTube). A good example is the Home Tree Initiative, a scheme led by James Cameron and 20th Century Fox, in association with the Earth Day Network, that was launched alongside *Avatar*’s home release (on Earth Day). Buyers of DVDs could register a code online and adopt a tree. The initiative achieved its goal of planting a million trees worldwide in 2010–2011 (Taylor 2013).

Involving conservation professionals at the outset of a project can allow for horizon scanning for potential conservation-related issues that may arise (Cook et al. 2014), and the inclusion of additional information or existing evidence can contribute to this. For example, following the apparent but unanticipated impact of *Finding Nemo*, Disney-Pixar sought advice from the Association of Zoos and Aquariums on mitigating a repeat of the Nemo effect following the sequel *Finding Dory* (2016). The collaborators encouraged responsible fish buying and ownership as part of the film’s promotional

campaign (e.g., the poster *Selecting the Right Pet Fish*) and produced an educator's guide that included information about marine species and their conservation. This example neatly highlights the benefits that could be obtained by using research on the conservation outcomes of previous movies to guide future engagement with the film industry.

This mitigation strategy draws some parallels with the suggestion that film studios that take advantage of particular species or ecosystems should contribute to their conservation (Jepson et al. 2011), which is equivalent to the idea of payments for ecosystem services (Redford & Adams 2009). However, as well as generating some controversy (Jepson & Jennings 2013; Wunder & Sheil 2013), this proposal revealed how difficult it would be to determine to what extent such an approach might work, given the lack of research and evidence surrounding movie impacts on biodiversity. Once again, this demonstrates the need to robustly assess these impacts.

If this comes across as a plea to Hollywood, we are not suggesting the movie industry become conservation campaigners. Rather, we are primarily advocating greater efforts from conservationists and researchers to understand, access, and take advantage of the opportunities cinema offers to share unsung species, key habitats, and important issues. Industry engagement strategies need to be positive, collaborative, and, at least initially, proposed and promoted by conservationists. In an information-saturated and screen-dominated age, it is vital that conservationists engage with the media through which they are attempting to be heard to reach the widest possible audiences. There are a number of possible avenues for developing partnerships and initiatives, such as using existing industry communication channels with non-governmental organizations or professional bodies within conservation to propose collaborations or offer advice; the development of voluntary certification schemes for conservation credentials (cf. the American Humane Society's No Animals Were Harmed certification); and recognition or endorsement of good examples and role models. Many filmmakers are already interested in conservation and environmental issues. Providing opportunities for industry professionals to enhance audience awareness and encourage behavioral change therefore has the potential to be a very powerful tool.

Conclusions

Hollywood offers enormous opportunities to raise broad, if shallow, awareness of a wide variety of conservation issues. Conservationists should therefore be prepared to interact with the movie industry, and filmmakers might also be encouraged to realize their potential to make a difference. Further, generating a better understanding of the impacts of cinema on conservation issues (applying

the framework provided in Figure 1 and Table 1) will be integral to both harnessing the power of the silver screen in the future and to mitigating negative impacts it may have. A robust evidence base will be crucial for enabling these processes.

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Supporting Information

Additional methods, including R code (Appendices S1 and S2), are available online. The authors are solely responsible for the content and functionality of these materials. Queries (other than absence of the material) should be directed to the corresponding author.

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