

# Queering animal sexual behavior in biology textbooks

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**B**iology is instrumental in establishing and perpetuating societal norms of gender and sexuality, owing to its afforded authoritative role in formulating beliefs about what is “natural”. However, philosophers, historians, and sociologists of science have shown how conceptions of gender and sexuality pervade the supposedly objective knowledge produced by the natural sciences.<sup>1</sup> For example, in describing animal relationships, biologists sometimes use the metaphor of marriage, which brings with it conceptions of both cuckoldry and male ownership of female partners.<sup>2</sup> These conceptions have often led researchers to overlook female behavior and adaptations, such as female initiation of mating. Such social norms and ideologies influence both theories and research in biology.<sup>3</sup> Social norms of gender and sexuality also influence school cultures.<sup>4</sup> Although awareness of gender issues has had a major impact in Sweden during recent years, the interventions conducted have been based on a heteronormative understanding of sex; this has rendered sexual norms a non-prioritized issue and thereby rendered non-heterosexuals invisible

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<sup>1</sup> Haraway, 1988; Harding, 1993; Keller, 1982.

<sup>2</sup> Lawton, Garstka and Hanks, 1997.

<sup>3</sup> Gowaty, 1997a; Hrdy, 1986; Zuk, 2002.

<sup>4</sup> Bromseth, 2009.

in teaching and textbooks.<sup>5</sup> Since this research was published in 2007 and 2009,<sup>6</sup> norm critical pedagogics<sup>7</sup> have been included in the Swedish National Agency for Education's guidelines for teaching. This inclusion represents one way to tackle the recurring problem of heterosexuality being described as a naturalized "normal" behavior and homosexuals, bisexuals and transsexuals being described from a heteronormative perspective.

In this paper, I employ gender and queer perspectives to scrutinize how animal sexual behavior is described and explained in Swedish biology textbooks. The analysis is based in gender and queer theory, feminist science studies, and evolutionary biology.

The article begins with an outline a discussion of my theoretical framework, relating gender and queer perspectives on evolutionary biology to a discussion of queer methodology. I then scrutinize some empirical examples drawn from five contemporary biology textbooks used in secondary schools (by students aged 16-18 years old). Finally, I discuss the implications of the textbooks' representations of animal sexual behavior, the problems of and need for a "textbook-version", and providing examples of what an inclusive approach to biology education might look like.

## Gender and queer perspectives

Gender studies is mostly concerned with critical investigations of the cultural construction of gender as it occurs across various times and cultures. Although gender studies have largely adopted a constructionist framework, this does not imply a denial of

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<sup>5</sup> Bromseth and Willow, 2007.

<sup>6</sup> Bromseth and Willow, 2007; Bromseth, 2009.

<sup>7</sup> Bromseth and Darj, 2010.

material reality. Rather, gender studies problematizes how material reality is portrayed; for example, by questioning stereotypical portrayals of the sexes and reminding us that portrayals and descriptions of biological phenomena are themselves cultural conceptions.<sup>8</sup>

Queer studies challenges “heteronormativity” – the ways in which heterosexuality, through everyday speech and behavior, is presented as the only natural and normal way of living, while other sexualities are simultaneously rendered abnormal.<sup>9</sup> Queer theories are critical theories for emancipating thought and action, while questioning both ways of knowing and indeed the very nature of being.<sup>10</sup> Queer theories also involve questioning binary categorizations.<sup>11</sup> Many researchers are engaged in applying queer theories to research and activism in school education systems.<sup>12</sup> Vicky Snyder and Francis Broadway argue that queer theory can have a number of implications for science teachers: it offers ways to foster critical thinking, to question categorizations and norms, and to challenge cultural practices that privilege heterosexuality as normal and natural.<sup>13</sup> These perspectives enable critical analysis of the ways in which knowledge is produced and represented. Therefore, what is rendered invisible by these norms, as they impact upon teaching in practice, is relevant to students’ views of nature, of other human beings, and their self-image.

To teach biology is to mediate knowledge that shapes the

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<sup>8</sup> Thurén, 2003.

<sup>9</sup> Kulick, 2004; Rosenberg, 2002.

<sup>10</sup> Greene, 1996.

<sup>11</sup> One critique of queer theories has been that they have been formed from a mainly white subject position and that sexuality is inextricably linked with racialized subjectivities (e.g. Barnard, 1999).

<sup>12</sup> Bromseth and Darj, 2010; Bryson and de Castell, 1993; Kumashiro, 2002.

<sup>13</sup> Snyder and Broadway, 2004.

understanding that students create of themselves and of science. Snyder and Broadway suggest that:

Using the lens of queer theory, we can view the hegemonic matrix, interrupt heteronormative thinking, and broaden all students' potential for interpreting, representing, and perceiving experiences.<sup>14</sup>

Gender and queer perspectives have the potential to increase critical thinking about science among both teachers and students through elucidating the fact that scientific endeavors are always conducted within a social context.

## **Gender perspectives on evolutionary theories of sex differences**

In order to contextualize my analysis, I will begin with a brief overview of the development of evolutionary theories, explaining sex differences from a feminist science studies perspective.

Sexual selection is the element of Charles Darwin's theory of natural selection most often used to explain sexual difference as evident in morphology and behavior, and it also provides the basis for the textbook descriptions analyzed here.<sup>15</sup> Darwin explained the evolution of sexual difference by sexual selection as mainly due to male-male competition (resulting in, for example, male horns) and female choice (resulting in, for example, male ornaments), but he also mentioned exceptions, such as instances in which females compete for males. It has been pointed out that a focus on male competition and female choice, which both consider how variation in male reproductive success

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<sup>14</sup> Snyder and Broadway, 2004, p. 621.

<sup>15</sup> Darwin, 1871.

is produced, has resulted in the assumption that sexual selection is always strongest in males and unimportant for females.<sup>16</sup> Darwin, although describing much variation among species, generalized his observations into a collective view of eager, competitive males and coy, choosy females.<sup>17</sup> This depiction has been criticized, especially from a gender studies perspective,<sup>18</sup> and numerous recent findings, such as those involving female multiple mating, have changed the theoretical framework within which sexual selection research is undertaken.<sup>19</sup>

Anisogamy (a form of reproduction in which the sexes produce different sized sex cells), provides a biological definition of the sexes: individuals producing large sex cells are females, those producing small sex cells are male. This asymmetry of initial investment, in combination with parental investment, has been suggested as causing sex differences in sexual strategies, so that carriers of small gametes compete for access to females, and females are choosy about mates.<sup>20</sup>

However, proponents of the dominant theoretical framework for studying sexual selection today continue to use their criticized basic assumptions, namely: 1) Male reproductive success is more variable than that of females, 2) Males gain more by increasing mate number than do females, and 3) Males are generally eager to mate and hence are indiscriminate in mate choice, while females are choosy and less eager.<sup>21</sup> Even though these notions might hold true in many cases, this framework has, until the last four decades, hindered research into, for example, female mating

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<sup>16</sup> Gowaty, 1997a.

<sup>17</sup> Darwin, 1871.

<sup>18</sup> Gowaty, 1997b; Hrdy, 1981, 1986.

<sup>19</sup> Knight, 2002.

<sup>20</sup> Parker, Baker and Smith, 1972.

<sup>21</sup> Dewsbury, 2005.

outside of a social pair, male choice, and the cost of sperm.<sup>22</sup>

## Current evolutionary biology

Currently, as evidence for the variability and dynamics of sexual strategies accumulates (it is almost a ubiquity that females mate with multiple partners), sexual selection theory is itself transforming. Evolutionary biology has partly incorporated females' role in evolution, by (for example) highlighting other sexual selection mechanisms: male choice, female-female competition resulting in variation of female reproductive success, male coercion of female choice (males may aggressively condition female behavior) and interactions between the sexes other than mate choice which influence reproductive success.<sup>23</sup> The number of studies of male mate choice has increased relatively recently: discoveries of females in some species gaining as much as males in reproductive success by multiple mating, and females actively initiating mating, form part of an ongoing re-evaluation of traditional views of female and male reproduction.<sup>24</sup> Recent developments have also moved towards a more inclusive view of variation in sexual behavior, for example, same-sex sexual behavior.<sup>25</sup> Same-sex sexual behavior has been found in over 1500 species, among a wide variety of animals.<sup>26</sup>

Anisogamy and parental investment may partly explain sexual difference in mating strategies, but the connection is not as simple as was first theorized, and a more complex view has emerged.<sup>27</sup> Traditional theories postulate that anisogamy and parental

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<sup>22</sup> Tang-Martinez and Ryder, 2005.

<sup>23</sup> Gowaty, 1997a.

<sup>24</sup> Tang-Martinez, 2010.

<sup>25</sup> Bagemihl, 1999; Bailey and Zuk, 2009; Sommer and Vasey, 2006.

<sup>26</sup> Bagemihl, 1999; Bailey and Zuk, 2009; Roughgarden, 2004.

<sup>27</sup> Clutton-Brock, 2007.

investment cause mate competition and mate choice (sexual selection), but the causal relationship may be reversed so that sexual selection may cause differences in parental investment, which has been shown to be the case in cichlid fishes.<sup>28</sup> Furthermore, alternative models now predict sexual behavior in ways that do not rely upon the assumption of anisogamy.<sup>29</sup>

## Current evolutionary biology

The life sciences emerged from a positivistic tradition of striving to make objective and value-neutral measurements of the world. Within this tradition it is unusual to consider the impact that politics and culture exert upon the “doing of science”. Science is often envisioned as objective and thus as reflecting nature “as it really is”; as such, it may claim the ability to produce universalized facts. This understanding is probably prevalent among students reading biology textbooks in school. By contrast, feminist science studies have shown that science is a cultural process which is influenced by social ideologies.<sup>30</sup> Hence, another way of presenting science in context is to emphasize that science is itself context bound, value laden, and indeed a human endeavor in which human beings are critical in formulating the theoretical framework through which nature is observed, interpreted, and named. This is not to suggest that nature itself is a construction, but rather that our understandings and presentations of nature will always be influenced by the theoretical framework that we are using in order to access it. Alternatively, as some theoreticians have argued, we may say that knowledge about nature is co-constituted, so that nature is an

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<sup>28</sup> Gonzalez-Voyer, Fitzpatrick and Kolm, 2008.

<sup>29</sup> Gowaty, 2008; Gowaty and Hubbell 2005, 2009.

<sup>30</sup>e.g. Fisher, 2011; Haraway, 1988; Harding, 1993; Mayberry, Subramaniam and Weasel, 2001.

active participant in knowledge-making.<sup>31</sup>

## Methods

I have conducted a textual analysis of Swedish secondary school biology textbooks. I selected the five until recently available textbooks<sup>32</sup> for education in biology as a subject (there are also books available for education in nature oriented subjects, which give a less comprehensive exposition of animal behavior) in order to ensure a substantive sample. I have selected those sections that describe and explain animal sexual behavior.<sup>33</sup> Various authors have chosen to discuss animal sexual behavior in slightly different sections. Inga-Lill Peinerud et al. have a focused section on “Sexual strategies” under the over-arching heading “Behavioral Ecology”, while Gunnar Björndahl et al. have two sections under the heading “Behavioral Ecology”: “Reproduction“ and “Different mating systems”, and also refer to them in the Summary of that chapter. Anders Henriksson has one page on “Sexual selection” in a section on “life evolving”; under “Behaviors and life strategies” there are sections on “Birdsong”, “Different kinds of territories”, “Fight for a territory”, “Partner choice and relations” and “Toad seeks partner”. Lars Ljunggren et al. use the heading “Evolutionary ecology and ethology” to cover sections on “ornaments”, “To invest in the offspring”, “Polyandry”, “Mate guarding”, “Nuptial gifts” and “Polyandrous females”. Janne Karlsson et al. have a section on “Sexual systems” under “Behavioral Ecology”.

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<sup>31</sup> Barad, 2007; Latour, 1987.

<sup>32</sup> Biologi A: Peinerud, Lager-Nyqvist and Lundegård, 2001; Biologi A med Naturkunskap: Karlsson, Krigsman, Molander and Wickbom, 2005; Biologi Kurs A: Henriksson, 2003; Liv i utveckling Biologi A: Ljunggren, Söderberg and Åhlin, 2007; Spira Biologi A: Björndahl, Landgren and Thyberg, 2007.

<sup>33</sup> See appendix for selected sections. All books include sections on biological diversity (covering e.g. bacteria, plants, animals), sex determination mechanisms, sexual and asexual reproduction and evolution.



Guiding questions for the analysis have been: How is sexual difference in animal sexual behavior described and explained? What are the emerging, primary narratives, and are there counter-examples? Are anthropomorphic terms used? What is described as the norm and what is described as deviant? Which animal examples are selected, and what do they represent? Are there any examples of variation in sexuality, and if so, how are these described? I read the texts closely in order to identify common themes, then re-read the texts several times to ensure all themes were covered similarly. The emerging themes were: 1) Descriptions and explanations of sex differences, 2) Counter-examples, 3) Choice of animal examples and illustrations, 4) Criticism of anthropomorphism and value judgments, 5) Diversity in sexual behavior. Under the first theme, I have identified several sub-themes: Males compete, females choose and care; Active males/passive females; Anisogamy as a general explanation for sex differences in behavior; Parental investment as an explanation for sex differences in behavior; Mating system theory; Extra-pair paternity/Certainty of paternity as explanation for sexual behavior; and Alternative reproductive tactics. I extracted excerpts and described the coverage in accordance with the themes, both examples that illustrate the main narratives and counter-examples. Since my aim was to analyze not just whether these themes are covered, but how they are represented, I have focused on excerpts that are interesting from gender and queer perspectives.

I noted the number of animal species, which animal groups were presented and whether the text was implicitly referring to any particular group of animals. The illustrations were scrutinized for which animal species were represented and what the illustrations were conveying. I also noted value judgments and whether there

were instances of anthropomorphic terminology. Finally, I checked whether the books covered variation in sexuality, for example, examples of same-sex sexuality. I have decided not to privilege any particular textbook; if the reader wishes to compare them, table 1 (at the end of the article) gives an overview of how the various textbooks have covered the themes of the analysis.

## **Analysis of textbooks from gender and queer perspectives**

The results of the analysis are summarized in table 1, where I provide examples of the emerging patterns and themes on which my analysis focuses. In the results section, I provide excerpts from the textbooks as well as my interpretations and reflections (an overview of the themes and additional excerpts are available in table 1).

### *Descriptions and explanations of sex differences*

#### Males compete, females choose and care

Generally, among the textbooks, female and male sexual strategies are explained in dichotomous terms: “females choose and males compete”,<sup>34</sup> “males have to show their competence” and if he “competes with other males” as well as “shows his competence as a father”, he can “be accepted and be allowed to fertilize the female's eggs”.<sup>35</sup> “Most often the most ostentatious, largest and strongest males win the struggle to get to mate”<sup>36</sup> and

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<sup>34</sup> All citations are translated from Swedish to English by the author.

<sup>35</sup> Peinerud et al., 2006, for page numbers see appendix.

<sup>36</sup> Ljunggren et al., 2007.

“females most often choose partners”.<sup>37</sup> One of the five textbooks did not mention male competition.

While giving the same general picture, some accounts in the textbooks open the readers’ minds to more diverse possibilities, such as “different species have different sexual systems” and “the pre-requisites are most often different for the two sexes”.<sup>38</sup> There is also a difference between general claims such as “females that care and males that waste”,<sup>39</sup> and making the same claim but adding “most often”<sup>40</sup> in front of it; doing so allows for a more variable understanding of sexual difference in behavior.

In one of the textbooks, sexual difference in sexual motivation is described as follows:

Males have high sexual motivation and react more easily than females on sexual signals. As mentioned a male turkey can try to mate with a briefcase, which would hardly be expected by a female. The female demands stronger signals to react and is more selective for which signals she reacts to.<sup>41</sup>

This statement is in line with the dominant paradigm’s criticized assumption of generally eager males and coy females, discussed previously.

While it is often ascertained that females choose, there are very few descriptions of females actually choosing; one is an account of an experiment in which the tails of widow-birds were

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<sup>37</sup> Henriksson, 2003. One might think that these two statements are contradictory, but they reflect two different mechanisms by which sexual selection may act to produce sex differences, such as horns and ornaments.

<sup>38</sup> Karlsson et al., 2005.

<sup>39</sup> Peinerud et al., 2006.

<sup>40</sup> Henriksson, 2003; Karlsson et al., 2005; Ljunggren et al., 2007.

<sup>41</sup> Karlsson et al., 2005.

experimentally prolonged or shortened, which found that females preferred long tails.<sup>42</sup> This observation leads to the next theme, that of describing males as generally active and females as passive.

### Active males/passive females

The portrayal of males as inherently active and females as inherently passive represents a deep cultural dichotomy, especially pronounced in Western societies.<sup>43</sup> Janne Karlsson et al. write, concerning birds: “Among species in which one partner has to guard the nest while the other makes flights to eat, the male often *mates with the female* when they return”<sup>44</sup> [my emphasis]. Concerning sea elephants: “It is almost only the dominant males that mate”. Another example: “Since practically all females among both birds and mammals *become fertilized*, from an evolutionary perspective it is more beneficial for a weaker individual to be a female than a male”<sup>45</sup> [my emphasis]. Though in many species males do have larger variation in reproductive success among themselves than females, many species also show similar patterns for males and females.<sup>46</sup> Furthermore, there are mammal species in which dominant females suppress reproduction of sub-dominants in the group (e.g. wolfs, primates<sup>47</sup>), hence not all females get the chance to mate or reproduce. Similarly, Karlsson et al. describe female mating in passive terms: “The male that manages all this [fighting for a territory etc.] gets accepted and *is allowed to fertilize* the

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<sup>42</sup> Karlsson et al., 2005.

<sup>43</sup> Haraway, 1986.

<sup>44</sup> Karlsson et al., 2005.

<sup>45</sup> Ljunggren et al., 2007.

<sup>46</sup> Tang-Martinez, 2010.

<sup>47</sup> e.g. Abbot, 1984.

female's eggs"<sup>48</sup> [my emphasis]. In line with this, females are generally described as passive in narratives of sexual selection: "Males fight intensively among each other [...] dominant males hold a harem of females. Almost only the dominant males mate".<sup>49</sup> However, one figure illustrates how females may influence mating: "A sea elephant female that mates with a male wobbles her body back and forth and screams loudly. A male with higher rank that hears the screams chases away the intruder and mates with the female himself".<sup>50</sup> Even when female choice is exemplified, the example illustrates a mating system with pronounced male domination.

#### Anisogamy as a general explanation for sex differences in behavior

Four of the textbooks refer to the sexual differences in the size of the sex cells (anisogamy) in order to explain behavior in more or less deterministic terms: "Because the sex cells among males and females differ the evolutionary strategies in the game has become different", and "the difference in size and amount of sex cells has through the course of evolution contributed to increase the differences between the sexes among many animals".<sup>51</sup> Again, a small inclusion of "at least partly" makes a considerable difference in how static sexual difference is perceived to be: "Much behavior can at least partly be explained by the male's sperm being much smaller and not as costly to produce as the female's egg cells".<sup>52</sup> "For a female it is a large cost in the form of energy to produce eggs. A male's sperm are "cheaper" to produce and therefore he can afford considerably more sex cells

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<sup>48</sup> Peinerud et al., 2006.

<sup>49</sup> Karlsson et al., 2005.

<sup>50</sup> Karlsson et al., 2005.

<sup>51</sup> Peinerud et al., 2006.

<sup>52</sup> Björndahl et al., 2007.

than the female”.<sup>53</sup> Janne Karlsson et al. refer to the high cost of reproduction for females producing eggs, gestating and lactating, and to the importance of carefully choosing mates, compared to males who can mate with many at a small cost.<sup>54</sup> By relying heavily on mammalian examples in order to make generalizations about animal behavior (see choice of animal species below), the described pattern becomes biased toward female care and parental investment. In scientific discussions, however, the degree to which the initial investment in gametes affect subsequent sexual strategies remains contested.<sup>55</sup>

### Parental investment as an explanation for sex differences in behavior

Several of the books refer to the large cost of care, either explicitly or implicitly, using mammalian examples as the basis of the argument. For example: “In order for a female to produce a large amount of surviving offspring the female’s sexual strategy becomes to invest in *quality* of the care of offspring”. “She shall also readily find a male, that can help her with this”. “Since the male’s production of sperm does not require much energy it is instead the number of females he can fertilize during a lifetime that determines how many offspring he can get. The male therefore invests in *quantity*”.<sup>56</sup> Here the implicit assumption is that we are dealing with mammals, or birds. Among animal species overall, however, few undertake any care of their offspring. The (generalized) female is assumed to care, and the male to “help” with that caring, a description colored by cultural assumptions about the gendered responsibility to care. In

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<sup>53</sup> Henriksson, 2003.

<sup>54</sup> Karlsson et al., 2005.

<sup>55</sup> e.g. Ellingsen and Robles, 2012.

<sup>56</sup> Peinerud et al., 2006.

contrast, one textbook explains that: “Parents put a lot of energy into reproduction and care of the offspring”<sup>57</sup> – a gender-neutral description which does not reflect culturally specific gender stereotypes.

### Mating system theory in the textbooks

Polygamy and monogamy are mentioned in all the textbooks, and all but one mention both polygyny (a male mating with several females) and polyandry (a female mating with several males). In one textbook, the term polygamy is described as, and only in the context of, “a male has several females”.<sup>58</sup> Polygamous literally means “many marriage”, and so is a gender-neutral term. Hence, while it is not strictly incorrect to use it in the way described above, the opposite pattern – of females having relationships with several males – is made invisible in this particular example.

“Polygamy among mammals” is often contrasted with “monogamy among birds”.<sup>59</sup> Recent decades of DNA-testing have revealed that few birds are mating monogamously, and although many birds live in social monogamy, the majority of them mate numerous times with several partners.<sup>60</sup>

Examples illustrating mating system theory to be found in the textbooks include a description of bee-eaters (birds) in which males defend territories with resources upon which the females depend, and females who mate with territorial males.<sup>61</sup> Another example is the polygyny threshold model, describing how females may prefer to mate with an already mated male if his territory

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<sup>57</sup> Ljunggren et al., 2007.

<sup>58</sup> Peinerud et al., 2006.

<sup>59</sup> Björndahl et al., 2007; Henriksson, 2003.

<sup>60</sup> Griffiths, Owens and Thuman, 2002.

<sup>61</sup> Karlsson et al., 2005.

provides more resources than that of another, unmated male.<sup>62</sup> In accordance with the gender criticism of the scientific accounts, these descriptions depict females as passive resources for males, while many other examples show that active interactions between females and males result in the mating system.<sup>63</sup>

### Extra-pair paternity/Certainty of paternity as explanation for sexual behavior

Several books mention how DNA-analysis has revealed both frequent female multiple mating and the ways in which males ensure their paternity, such as by guarding females. For example, “Eurasian Sparrow hawk [pairs] mate several hundred times during one breeding season. In this way he ensures that he is the one to become father of the pair's young”.<sup>64</sup> For perhaps obvious reasons, this category of explanations is rather male biased, which is not necessarily wrong. However, while they are all described from a male perspective of guarding females or ensuring high levels of paternity by other means, there are other examples one might choose, such as female aggressive behavior to keep other females from laying eggs in their nests, i.e. strategies for maternity assurance.<sup>65</sup>

### Alternative reproductive tactics

Alternative mating tactics are described in three of the five textbooks, for example: “There are also males, often younger, that choose to prowl around, court and fertilize females that have already formed a pair with a male”.<sup>66</sup> This wording is rather

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<sup>62</sup> Karlsson et al., 2005.

<sup>63</sup> Gowaty, 1997a.

<sup>64</sup> Peinerud et al., 2006.

<sup>65</sup> Gowaty and Wagner, 1988.

<sup>66</sup> Peinerud et al., 2006.



negative and frames alternative reproductive tactics as a behavior outside of the norm. It also suggests the male plays the active part while females have no influence over mating. Extra-pair matings and alternative reproductive tactics are often described in culturally loaded terms (see anthropomorphic terminology below) such as young males who “prowl around”,<sup>67</sup> and are hence called “sneaky fuckers”.<sup>68</sup> Similarly, female Great Reed warblers are described as having “casual relations”,<sup>69</sup> which has a negative connotation, being suggestive of promiscuity.

Other examples of how alternative reproductive tactics are described include: “Large frog males attract females more than small ones. But the latter have a trick [...] to keep themselves in the vicinity of the large male that attracts most females”. “The ‘sneaky fuckers’ may then fertilize the eggs”.<sup>70</sup> In the scientific literature, “sneakers” is the common terminology; I have never before seen “sneaky fuckers” employed in a scientific context, and indeed the term turns up no hits on Web of Science, but a search for “sneakers” resulted in 181 matches.

### *Counter-examples*

That sexual behavior can be modified by environmental factors (for example, when male frogs adjust their song to predation pressure and female density<sup>71</sup>), is one instance of what I identify as counter-examples to the traditional generalizations of competing males and choosy females. These are examples that disrupt the presentation of strict patterns for male and female

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<sup>67</sup> Peinerud et al., 2006.

<sup>68</sup> Ljunggren et al., 2007; “Sneaky fuckers” is written in English in the original text.

<sup>69</sup> Ljunggren et al., 2007.

<sup>70</sup> Ljunggren et al., 2007.

<sup>71</sup> Karlsson et al., 2005.

sexual strategies. Similarly, Anders Henriksson describes how male singing abilities differ between two toad species depending on female density in the area and length of the mating season.<sup>72</sup> Furthermore, Janne Karlsson et al. discuss the phenomenon of members other than a social pair providing care for young (so called “helpers”) and mention that some insects reproduce through eggs developing into new individuals without fertilization.

Gunnar Björndahl et al. give examples of caring males in some fishes and birds, and point out that, among many fishes, neither sex care for young. Lars Ljunggren et al. mention that polyandrous females are often larger than males, that female cuckoos perform egg dumping, and that in praying mantis and spider species, the male can be eaten by the female during mating and thereby provide resources for the offspring. Inga-Lill Peinerud et al. observe that both males and females may abandon a partner with a clutch of eggs in their nest.<sup>73</sup> Hence, all textbooks provide one or more counter-examples to the main narrative (table 1).

### *General questions of representation*

In this section I consider the choice of animal examples, illustrations, anthropomorphism and value judgments in the descriptions, as well as the lack of examples of sexualities other than heterosexuality.

#### Choice of animal species

Three of the five books take mammals as an implicit starting point for discussing sex differences in sexual strategies among

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<sup>72</sup> Henriksson, 2003.

<sup>73</sup> Peinerud et al., 2006.

animals. This leads to an emphasis of female caring in relation to what is the most common pattern in animals overall, namely to not care for the offspring. The diversity of species per textbook illustrates how the authors have attempted to present diversity in this particular context (see table 1). Clearly, the overrepresentation of mammals or pair-bonding birds, especially in two books, does not provide an accurate or even a thorough understanding of the diversity of animals' sexual strategies.

### Choice of illustrations

In Inga-Lill Peinerud et al.'s textbook, there are two illustrations for this section, both of pair-bonding birds, namely a pair of bullfinches accompanied by the caption “the female that chooses, the male that displays”, and a pair of swans “that often live in a life-long relationship and therefore it has not been as important for the male to put extra resources on external attributes as bright colors”.<sup>74</sup> In this book, the choice of examples mirrors a (human) cultural norm of opposite-sex pair-bonding species in which (by the descriptions in the textbook) females care by default, while males may or may not choose to care. All the other textbooks have illustrated both polygamous and monogamous examples, and various other examples, while one textbook is also illustrated with diagrams (for details see table 1). The choice of illustrations probably reflects whether the authors are aiming to illustrate diversity or offering a general portrayal of sexual strategies.

### Anthropomorphic terminology

Generally, within the sciences, it is considered erroneous to use

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<sup>74</sup> Peinerud et al., 2006.

anthropomorphic<sup>75</sup> terminology to describe animal behavior, since to do so allegedly departs from the objective ideal of scientific work. Scientific literature is not devoid of anthropomorphic terminology, however, so in many cases the textbook terminology follows scientific convention. As Eileen Crist has shown, the behavioral sciences have contained two contradictory traditions: the tradition of natural history, to which Darwin belonged, which often used anthropomorphic terminology to describe animal behavior, and the subsequent classical ethology tradition in which such terminology was regarded unscientific.<sup>76</sup> Yet, others have argued that anthropomorphic terminology is related to the human capacity for feeling empathy with animals and hence should not be assumed to always be negative.<sup>77</sup> With the young audience in mind, it is especially important to reflect upon how anthropomorphizing affects their views of what is “natural” human behavior, such as common references to human forms of child care as observed in nonhuman animals: “father of the children”, “carrying a fetus”, “single father”.<sup>78</sup> These wordings, combined with value judgments following societal expectations of females to care, and notions that male caring is optional (see above and below), has the effect of mirroring and reproducing societal norms in accounts of animal behavior.

Other textbooks use “harem”, “betray”, “nuptial gifts”, “childhood”, “casual relation”, and “prowl around”, many of which have sexual connotations and give value-laden meanings to the descriptions, especially those of sexual relationships

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<sup>75</sup> Anthropomorphism is the “attribution of human motivation, characteristics, or behavior to inanimate objects, animals, or natural phenomena” ([www.thefreedictionary.com](http://www.thefreedictionary.com)).

<sup>76</sup> Crist, 1999.

<sup>77</sup> Libell, 2004/2009.

<sup>78</sup> Peinerud et al., 2006.

outside of a social pair. There is one textbook in which I did not find any anthropomorphic terminology, namely Henriksson's "Biologi Kurs A".<sup>79</sup>

Yet another example of anthropomorphic language is the description that: "One might say that four different roles have crystallized among males/females: faithful and unfaithful males, faithful and unfaithful females".<sup>80</sup> Biologists use the same terminology of fidelity/faithfulness/cuckoldry, but this use has also been criticized within the behavioral sciences.<sup>81</sup> Moreover, the question is whether it is appropriate to simplify animal behavior by categorizing males and females into four roles depending on their fidelity to their partner. What does the term "role" imply here?

#### Value judgment of male and female behavior

Deserting a partner with eggs in the nest is described in positive terms for males who "of course readily seek out another female as quickly as possible" and this "has been beneficial from a genetic point of view". The same behavior in females is described in negative terms involving the attribution of blame: "[when she leaves] the male has to choose between caring for the young himself or letting them perish", and "in this way even the female can increase the number of offspring somewhat". This is a notably extreme example of how cultural conceptions of male promiscuity and female caring are inscribed onto animals in the textbooks' accounts. From a scientific point of view, the male and the female increase their fitness equally, and their behavior is just as beneficial from a genetic standpoint. This is the only example

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<sup>79</sup> Henriksson, 2003.

<sup>80</sup> Peinerud et al., 2006.

<sup>81</sup> Gowaty, 1982.

in which these value judgments are so salient (but see the section of anthropomorphic terminology for more subtle examples).

### Diversity of sexual behavior

Only one of the textbooks mentions non-heterosexual sexual behavior, namely male frogs mounting both sexes. This same-sex interaction occurs because males are unable to distinguish the sex of other individuals until they emit sounds, which only males do.<sup>82</sup> I do not claim that this is untrue, but it is remarkable that there are no other accounts of same-sex sexual behavior in the textbooks. In the scientific literature, same-sex sexual behavior has often been described as abnormal, arising from mistakes, or renamed in order to avoid sexual implications – all reasons why it took a comparatively long period of time before the extent of such behavior to become known among biologists in general.<sup>83</sup> Gunnar Björndahl et al. even write that: “Even if all behavior aims at increasing the survival ability and carrying the genes on [to the next generation] it is especially obvious when it comes to the animals’ different mating behavior”. Thus, they express the (criticized) assumption that every behavior is adaptive.<sup>84</sup> This expression is especially noteworthy as it ignores the diversity of mating behavior, such as same-sex sexual behavior. Another book states that “reproduction is among those urges that are totally governed by instincts”.<sup>85</sup> This wording suggests that sexual strategies are genetically determined and hence fixed, which is greatly misleading.<sup>86</sup>

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<sup>82</sup> Henriksson, 2003.

<sup>83</sup> Bagemihl, 1999.

<sup>84</sup> For a critical perspective see e.g. Gould and Lewontin, 1979.

<sup>85</sup> Ljunggren et al., 2007.

<sup>86</sup> See for example a chapter summarizing mate choice flexibility in relation to ecological and social circumstances: Ah-King, 2010.

## Discussion

Current Swedish biology textbooks describe female and male sexual behavior as generally dichotomous and mutually exclusive: males compete, showing their ornaments and abilities, while females choose and care for the offspring. Although these generalizations may be in accordance with scientific consensus of general patterns in nature, females caring for offspring is a generalization based on the behavior of certain species, especially mammals. The most common pattern among animals overall is to not take any care of offspring, and among fishes it is common for males to care (Gunnar Björndahl et al. do point out that among many fishes neither sex care for their young). Overall the textbooks display a male-biased focus on male activity and male ornaments/weapons/strategies which, nevertheless, reflects the scientific literature.<sup>87</sup>

All the textbooks provide one or more counter-examples to these descriptions, and open up for a more varied view of sexual strategies as varying between species as well as being also dependent on ecological circumstances. This approach is an effective way of providing insight into nature's diversity. The number of animal species used as examples gives a hint as to whether the authors have maintained this provision of insight as a goal in their descriptions. Relying on bird and mammal examples alone allows for only a very limited view of female and male sexual behavior. Excessive simplification gives the impression that there is a lawfulness to how females and males behave, when in fact scientists are trying to make sense of, and often making generalizing explanations for, an immense diversity.

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<sup>87</sup> Fausto-Sterling, Gowaty and Zuk, 1997.

Furthermore, all descriptions of animal sexual behavior are focused on reproduction, and none of the textbooks mention the research of recent decades which shows enormous diversity in sexual behavior among animals.<sup>88</sup> This selective exclusion, combined with adaptationist claims such as: “Even if all behavior aims at increasing the survival ability and carrying the genes on [to the next generation] it is especially obvious when it comes to the animals different mating behavior”<sup>89</sup> and “reproduction is among those urges that are totally governed by instincts” designate all non-reproductive sexual behavior as abnormal. These descriptions reflect the heteronormative assumptions built into the Darwinian evolutionary theoretical framework combined with reductionist, adaptationist claims.

Textbooks are inherently oriented towards consensual understandings of current knowledge, since including the most recent and most controversial research findings could render editions redundant as new findings continue to be reported. It is perhaps not a coincidence, then, that there is such a thing as “the textbook version” – the simplified, conventional and perhaps outdated version. In this light, given the practicalities of textbook production and publication, it may seem unfair to criticize the textbook authors for simplifications and generalizations. However, writing textbooks involves the power of deciding what knowledge should be included and excluded. Furthermore, what is taught in most schools is guided by the content of the textbook.<sup>90</sup> At the same time, textbook authors have to relate to the Swedish curriculum goals of gender equity.<sup>91</sup> In the preceding analysis I have sought to distinguish between what is normative

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<sup>88</sup> Bagemihl, 1999; Bailey and Zuk, 2009; Sommer and Vasey, 2006.

<sup>89</sup> Björndahl et al., 2007.

<sup>90</sup> Snyder and Broadway, 2004.

<sup>91</sup> Lpg2011.



within animal behavioral studies and what may be due to the popularization of animal behavior in the textbooks. I have also provided a feminist critique of conventional wisdom in the animal behavioral sciences, such as the over-representation of the evolution of male behavior and ornaments, and the under-representation of sexual selection in females.<sup>92</sup> It might seem unfair also to criticize the use of anthropomorphic terminology, which is commonly used within the scientific literature, but it is important to note that within the scientific literature the term usually has a well-defined meaning that differs from its everyday meaning. The use of terms such as nuptial gifts, casual relations, father, parents and harem are loaded with culturally-specific meanings and also encourage the drawing of parallels between animal and human behavior. Furthermore, there is ongoing criticism within the scientific community of the use of such terms.<sup>93</sup>

Although this analysis reveals some problematic aspects from a gender and queer perspective, it also provides examples of solutions: showcasing diversity; avoiding stereotypes of female and male behavior; explaining how behavior varies in relation to ecological circumstances, and using gender-neutral language such as “parents invest in their offspring”, and “different species have different sexual systems”. When seeking to include examples of natural diversity across species within textbooks, there are pitfalls, one of which is that the diversity described may mirror normative understanding. For example, the description of one counter-example in particular, in which abandoning a nest is described in terms of completely different values depending on whether the subject is male or female, strengthens stereotypes instead of broadening perspectives. These portrayals may have a

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<sup>92</sup> Gowaty, 1997a; Hrdy, 1981.

<sup>93</sup> e.g. Gowaty, 1982; Karlsson Green and Madjidian, 2011.

large impact on what students perceive to be “natural” male and female behavior.

What does it mean to teenagers to read that males naturally have higher sexual motivation than females? Martha McCaughey has shown how projections of the cave man have been used by people in motivating male sexual aggression against females, behaving in unruly, brutal, and asocial ways.<sup>94</sup> Additionally, scientific findings of sexual difference have been distorted and misappropriated, which has affected Western society’s collective understanding of gender roles.<sup>95</sup> Furthermore, the dominant paradigm’s contentions of eager, indiscriminate males and coy, choosy females are not in accordance with current evidence of females’ active roles in sexual interactions.<sup>96</sup> Females mate multiply in many species and have been shown to overtly initiate and seek matings.<sup>97</sup> Indeed, a rather depressing picture of female sexuality emerges from reading recurring, male-focused descriptions, and in addition, there is one example of a female sea elephant screaming when a male mates with her, leading to a higher-ranked male chasing away the first male and mating with her instead. The text does not report whether females ever do not scream during mating, or whether they may not approve of any mating they are subjected to. Although animal examples are not meant to be taken as mirroring human behavior, it is nevertheless useful to ponder what picture emerges of female and male sexuality in nature. In contrast, it is generally known that it is impossible for male butterflies to mate with a female unless she accepts to mate.

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<sup>94</sup> McCaughey, 2009.

<sup>95</sup> Eliot, 2011.

<sup>96</sup> Tang-Martinez, 2010.

<sup>97</sup> e.g. Hrdy, 1981; Lawton et al., 1997; Small, 1993; Tang-Martinez, 2010.

In what sense does it matter that sexual behavior in animals is described almost only in a heterosexual context by secondary school textbooks? The silence and omission of variation in non-reproductive and non-heterosexual sexual behavior does impact on students' understanding of biology. Our understanding of biology, in turn, affects our social identity-making and often shapes discussions about, for example, having children or not, and sexual orientation. The belief that homosexuality "is unnatural" is one of the misconceptions many people have to deal with on a daily basis. Of course, morality should not be based on arguments of how things are in nature, because it is perfectly possible to argue for any stance depending on which natural examples one chooses and which perspective one adopts. For example, all the four possible combinations of claims about the incidence of homosexuality among humans and animals have been used: homosexuality among humans is unnatural/refined because it does not occur among animals, or homosexuality among humans is natural/beastly because it does occur among animals.<sup>98</sup> However, teaching about sexual diversity among nonhuman animals is one way to counter claims of homosexuality's "unnaturalness."

It is worthwhile here to recall that the term "heterosexuality" was coined only a little over one hundred years ago to describe sexual acts between a man and a woman that did not aim to result in reproduction, a practice which was considered by physicians at the time as a perversion that required a medical cure.<sup>99</sup>

### *A norm-critical perspective of sexual selection*

Biology still describes, explains and generalizes sexual behavior

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<sup>98</sup> Sommer and Vasey, 2006.

<sup>99</sup> Katz, 1995.

in stereotypic terms of what is the most common behavior for females and males. The language used expresses the norms of biological discourse by pointing out certain behavior or patterns as *alternative or reversed*.<sup>100</sup> Hence, such behavior is viewed as an exception to a general pattern while dividing several continua of behavior into conventional or reversed “sex-roles”.<sup>101</sup>

Recently, it has been suggested that sex should be viewed as a dynamic interaction between genetic sets and environments, as illustrated by multiple evolutionary examples of changes between genetic and environmental sex determination, as well as variability within individual development.<sup>102</sup> This is in line with recent developments in the field of ecological developmental biology.<sup>103</sup> Many animals change sex in relation to environmental or social circumstances. Mate choice strategies are flexible in relation to predation risk and density of potential partners (as pointed out in one of the textbooks), parasite load, age, and experience.<sup>104</sup> These findings should be incorporated in textbooks and teaching in order to provide a more contemporary and inclusive education for secondary school students.

## Recommendations

Why limit descriptions and discussions of sexual behavior to their reproductive functions? Recent developments in biology have shown that there are numerous other functions of sexual behavior, such as social bonding, affiliation, and conflict resolution.<sup>105</sup>

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<sup>100</sup> Ah-King, 2009.

<sup>101</sup> Ah-King, 2013; Ah-King and Ahnesjö, 2013; Ah-King and Nylin, 2010.

<sup>102</sup> Ah-King and Nylin, 2010.

<sup>103</sup> Gilbert and Epel, 2009.

<sup>104</sup> Jennions and Petrie, 1997.

<sup>105</sup> Bagemihl, 1999; Bailey and Zuk, 2009; Small, 1993.

Current textbooks describe female and male behavior as if they were distinctly different and mutually exclusive. It is important to give students knowledge of variation and overlapping distributions and to emphasize that an average represents a summary of data rather than what is “normal”.<sup>106</sup>

Even if the textbooks at hand are lacking information about variations in sexuality, there is much information available elsewhere about variation in sex and sexual behavior in animals. These are topics that usually generate interest, so why not develop student exercises involving exploration of sexual diversity among animals? Several chapters in Bagemihl’s *Biological Exuberance: Animal Homosexuality and Natural Diversity*, for example, can be used to provide historical accounts and reviews over evolutionary explanations of variation in sexual behavior. Some museums have produced exhibitions about variation in animal sexual behavior, such as “Against Nature?” at the Natural History Museum in Oslo<sup>107</sup> which has ambulated around Europe in the subsequent years. Sociologist Myra Hird describes how her social science students often take sex as an unchanging biological given and that they rely heavily on biological explanations of sex differences. She then describes how she problematizes their understandings of sex as static – through showing animal and human diversity (asexual reproduction, sex-changing and intersexuality), and introducing the perspective of science as a cultural system.<sup>108</sup>

I urge textbook authors to deepen their awareness of how gender and heteronormativity bias shapes the representation of animal

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<sup>106</sup> Condit, 2008.

<sup>107</sup> Natural History Museum in Oslo, 2006.

<sup>108</sup> Hird, 2003.

behavior, and to describe such behavior with care, care for what knowledge about biology means for the identity-making of young people. These textbooks have power over how biology and what is “natural” comes to be perceived in society at large. Feminist critiques of male bias in the natural sciences apply to science education too. Furthermore, as the analysis shows, simplifications do not have to be over-generalizations; variability and natural diversity are often more interesting than those examples sought out merely to mirror a human, pair-bonding, heterosexual, males-competing-and-females-caring norm.

In addition, gaining knowledge about variability in sex, sexual behavior and sexual characteristics, such as genitalia, includes not only awareness of deviations from norms, but the realization that we are all included in these continua. In my own teaching practices I aim to destabilize dichotomous conceptions of sex, as illustrated by a students’ take-home-message from one of my lectures: “[I learnt] that sex is not two poles but a scale and that I cannot know my sex”. This is not to imply that I deny sex differences or categorizations of women and men, but rather should be seen as a result of a discussion of intersexuality<sup>109</sup> and the insight that some intersex people realize their condition rather late in life. Hence, my goal is to problematize understandings of biological sex and to encourage students to adopt a critical attitude to knowledge itself.

## Conclusions

Overall, the textbooks offer dichotomous descriptions of females and males, and they are heteronormative in that they all describe sexual behavior in only the context of opposite-sex interactions and reproduction. However, there are also examples of openings

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<sup>109</sup> Dreger, 2008.

for understanding biological (heterosexual) diversity and sexual strategies as also dependent on ecological circumstances.

Much remains to be done before current textbooks will include recent developments in the understanding of sex and sexual behavior in animals. Changing stereotypical portrayals of animal sexual behavior into a more variable view of sex and sexuality will benefit students and provide a more accurate basis for the development of these issues.

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## References Appendix: Selected sections for analysis

Biologi A: Peinerud, Lager-Nyqvist and Lundegård 2001: “Sexual strategies” p. 133-135.

Biologi A med Naturkunskap: Karlsson, Krigsman, Molander and Wickbom 2005: “Sexual systems” p. 258-264.

Biologi Kurs A: Henriksson 2003: “Sexual selection” p. 61, Under Behaviors and life strategies: illustration p. 154, “Birdsong” p. 163, “Different kinds of territories” p. 164, “Fight for a territory” p. 165, “Partner choice and relations” p. 166, “Toad seeks partner” p. 167.

Liv i utveckling Biologi A: Ljunggren, Söderberg and Åhlin 2007: Under Evolutionary ecology and ethology: “ornaments” p. 63, “To invest in the offspring” p. 64, “Polyandry” p. 66, “Mate guarding” p. 66, “Nuptial gifts” p. 67-68, “Polyandrous females” p. 67.

Spira Biologi A: Björndahl, Landgren and Thyberg 2007: Under Behavioral ecology: “Reproduction” p. 211-212, “Different mating systems” p 212-213, “Summary” p. 214.

### Table 1.

Table 1. A summary of the analysis, themes and examples from the different biology textbooks.

|   | Peinerud et al. 2006   | Björndahl et al. 2007  | Henriksson 2003   | Ljunggren et al. 2007   | Karlsson et al. 2005  |
|---|--|--|---|---|---|
| <b>Males compete, females choose and care</b> | Yes, "females that care and males that waste"<br>"females that choose, males that display" | Does not mention male competition; implicitly uses mammals when describing general | Yes, bird song attracts partners and/or deters other males from entering his territory; | Yes, "Most often the most ostentatious, largest and strongest males win the struggle to get to mate"<br>"males may also invest in the offspring by participating in | Yes, "The pre-requisites are most often different for the two sexes"<br>Female choice of song, plumage, |

|  |  |   |   |   |   |
|--|--|---|---|---|---|
|  |  | patterns of sex differences: "males do not invest much in each offspring" "female... carry a fetus" and need to be careful in partner choice    | "females most often choose partners"  | the care"   | male feeding. Male bullfrogs occupy territories, sea elephant males fight intensively with each other   |
| Males active, females passive                                    | "To show that he will do as a father [...] perhaps first builds the pair's nest and fights for a territory" "The male that manages all this gets accepted and is allowed to fertilize the female's eggs."  |   | "...the males are allowed to fertilize the eggs"  | "Since practically all females among both birds and mammals become fertilized..." | "Among species in which one partner has to guard the nest while the other make flights to eat, the male often mates with the female when they return" [Sea elephants:] "It is almost only the dominant males that mate."                                    |
| Anisogamy as general explanation for sex differences in behavior | Yes, "because the sex cells among males and females differ the evolutionary strategies in the game has become different." "females invest in quality of the care of offspring" "it is the number of females he can fertilize during a lifetime that determines how many offspring he | "Much behavior can at least partly be explained by the male's sperm being much smaller and not as costly to produce as the female's egg cells." | "For a female it is a large cost in the form of energy to produce eggs. A male's sperm are "cheaper" to produce and therefore he can afford considerably more sex cells than the female." |   | "The female uses a lot of energy to produce the eggs" "In total there is a large investment by the female. The male produces a very large amount of sperm to a relatively low "cost". A male can fertilize one female one day and another female the next." |

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|                               | can get. The male therefore invest in quantity."  |  |  |  |   |
| <b>Parental investment</b>    | "In order for a female to produce a large amount of surviving offspring the female's sexual strategy becomes to invest in <i>quality</i> in the care of offspring"  | "it takes a lot of resources to produce big eggs and carrying a fetus"                                   | "the female... that can reproduce only at maybe a single occasion per year, has more to loose from a bad mate choice than the male has" Implicitly long-lived animals, perhaps mammals | "Parents put a lot of energy into reproduction and care of the offspring"  | High cost of reproduction for females - more important to choose with care than for males who can mate with many at a small cost. |
| <b>Extra-pair paternity</b>   | "Through genetic tests of young birds, ... one has showed that a clutch of young do not always have the same genes as the male in the family"<br>"this could be the explanation for some pairs of birds ... to mate several hundreds of times during one breeding season" | "The male can never be sure of the paternity"  |  | "The viper female [...] mates with several males during her mating season.... the males have to compete to mate with the female, then their sperm have to compete to first reach the eggs" "DNA-fingerprinting [...] can reveal the identity of the father"; In the Great Reed warbler (bird), females have "casual relations" | DNA-analysis has shown that "up to a third of the young among some bird species have other fathers than the mother's partner"     |
| <b>Certainty of paternity</b> | Yes, "The Eurasian Sparrowhawk mates several hundred times during one breeding season. In   | "The male can never be sure of the paternity. The more probable it is that he is the father, the more he |  | "male birds often guard their female especially strictly during the days before egg laying"  | "There are several strategies to ensure certainty of paternity for the young he will help bringing up" (birds) "to mate often"    |



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|  | this way he ensures that he is the one to become father of the pair's young."   | performs care of the offspring."  |   |   | "to guard his female"   |
| <b>Alternative reproductive strategies</b> | "there are also males, often younger, that choose to prowl around, court and fertilize females that have already formed a pair with a male" |   |   | "Sneaky fuckers" among char fishes  | bullfrogs, territorial males and small non-calling satellite males. Sneaking male sea elephants.  |
| <b>Polygamy</b>                            | Described as "a male that has several females"  | polygyny, polyandry   | "Polygamy among mammals" large size difference correlated with polygyny and intense male competition  | polygyny, polyandry large size difference correlated with polygyny/polyandry  | "Polygamy among mammals" Polygamy as either polygyny or polyandry   |
| <b>Monogamy</b>                            | "for animals living in monogamy it is not as important for the male to invest in [...] external attributes"                                 | "monogamy is quite common among birds"                                    | "monogamy among birds"  | Not mentioned explicitly, but "males living in crowds usually have larger testicles that monogamous males" and "it is important for a male to make sure that the female does not betray him."   | "90 % of birds are monogamous" but also includes an example of extra-pair paternity   |
| <b>Counter-examples</b>                    | "Sometimes [...] after the female has laid her eggs, the female leaves the nest"  | Males caring in some fishes and birds; among many fishes neither sex care | Contrasting two toad species, one with intense male competition and one with exaggerated male singing abilities depending on female density | Polyandrous females are often larger than their males; female cuckoos egg dumping; in praying mantis and spiders the male can become the nuptial gift and be eaten by the female during mating; among birds few species have penises. | Some insects reproduce through eggs developing into new individuals without fertilisation; helpers at the nest (caring individuals that are not parents). Male frogs adjust song to predation |

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|                      |  |   | and length of mating season  |   | pressure and female density.  |
| <b>Animal taxa</b>   | Implicitly mammals, Birds, 4 species             | Implicitly mammals, 5 birds, red deer,      | Implicitly mammals, 12 species of birds, mammals generally and 1 primate, 2 ungulates, sea lions, plus snakes, 3 toads,  | 6 species of birds, hedgehog, giant deer, red deer, lions, opossum, cuckoo, frogs, salmon, 4 insects, spiders.  | 6 Mammals, 7 birds, 2 frogs, 1 insect   |
| <b>Illustrations</b> | A pair of bullfinches; a pair of swans with eggs | Two swans; A male red deer and two females. | displaying peacock; male and female sea lion; pair of frogs; male Willow warbler attacking male model; male vipers wrestling; a pair of stork; Hamadrias baboons; male toads in a struggle for a female; chirping toad | Mating seagulls. Polygynous capercaillie male with females. A big and a small male char about to mate with a female. Mecoptera (insect) presenting nuptial gift and mating with female. | Singing starling; male feeding female Arctic tern; diagram of male sand martins guarding females during egg laying; lekking male black grouse; diagram of number of females per male Paradise Whydahs depending on tail length; diagram of number of surviving embryos of frogs depending on male body length; diagram of number of matings for male sea elephants depending on rank; fighting male sea elephants; a pair of mating sea elephants, in which the female is |

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| <b>Antropomorphic terminology</b>                            | father of the children, carrying a fetus, single father, prowl around   | childhood, adolescence, harem, parents, carrying a fetus, father of the children   |  | harem, parents, betray, nuptial gift, casual relation                          | screaming<br>guards his own female, harem |
| <b>Different value judgement of male and female behavior</b> | Yes, deserting a partner with a clutch of eggs is described in positive terms for males, and negative for females |  |  |  |   |
| <b>Sexual behavior outside of reproduction</b>               | No  | No, "Even if all behavior aims at increasing the survival ability and carry the genes on it is especially obvious when it comes to the animals' different mating behaviors." | "Male frogs cannot distinguish females from males. [...] males mount both males and females", it is then described how mounted males emit a sound whereby they are released. | No, "reproduction is among those urges that are totally governed by instincts" | No  |

**Malin Ah-King** is an evolutionary biologist (PhD) and gender researcher at the Centre for Gender Research, Uppsala University. Her research aims to problematize the portrayal of biological sex as stable, make visible gender stereotypic and heteronormative notions in theory and research as well as to develop a theoretical framework for understanding biological sex as variable and constantly changing.