Shifting Intersexual Dynamics And Sexual Conflict Of Japanese Medaka (*Oryzias latipes*) Between Inverse Sex Ratios.

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Background Information

Sexual conflict theory is a spin-off of sexual selection, stating that males and females have conflicting evolutionary interests, with the interests of one sex being detrimental to the other.[1] Male fitness is limited by the number of females he can inseminate and thus maximizes matings and the number of offspring. In contrast, females fitness maximize their fitness through offspring quality and are thereby more choosy about their mates.[2]

Sex ratios (SRs) influence behaviour across vertebrate classes, including in fish groups. [2, 3, 4] Members of the excess sex may aggressively compete for mates of the limited sex, with the potential for some individuals to control access to the limited sex may control access to potential mates in order to maximize their own inclusive fitness, such as through mating disruption and spur sneak mating. [4, 5, 6]

- Operational sex ratios = viably mating males/ fertilizable females[7]

Japanese medaka (*Oryzias latipes*) are a common model research organism across many biological fields. Having well-established behavioural characterization, including for aggressive and courtship behaviours[9], Japanese medaka are an ideal organism in which to study sexual conflict. One major gap in published literature has been in male-female interactions in medaka.

Research Objective

Amending the knowledge gap in Japanese medaka sexual conflict by characterizing and determining trends between intersexual dynamics and SR.

Hypotheses and Predictions

1) Males in male-biased SRs will be overall more aggressive and will pursue more courtship attempts than males in female-biased SRs.
2) Females will be more choosy in male-biased SRs and express more resistance to mating through increased "head-up" refusal signals.
3) Females experience less courtship attempts from males in female-biased SRs and are less resistant to courtship.

Methods and Materials

Set-up

SR: 0.5 4 males 8 females	SR: 2 8 males 4 females
X 6	X 6

Observations

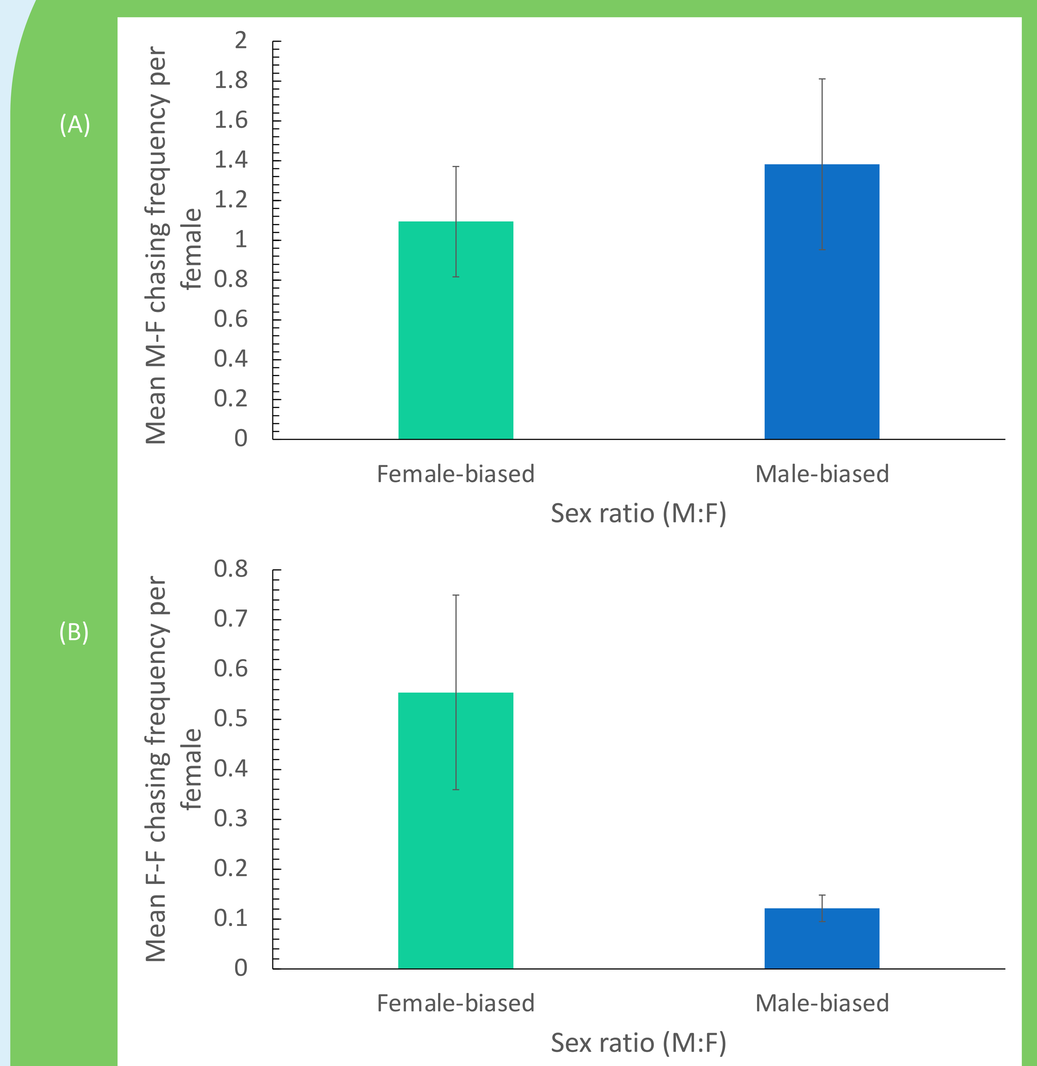
- Females were observed in 2-minute intervals over 4 rounds of observations.
- Females were reared and kept in tanks with inverse sex ratios of 0.5 and 2, with 6 replicates of each ratio for a total of 67 females observed. A total of 268 observations were held.

Behaviours

Table 1. Five behaviours were observed reflecting courtship rituals and aggression.

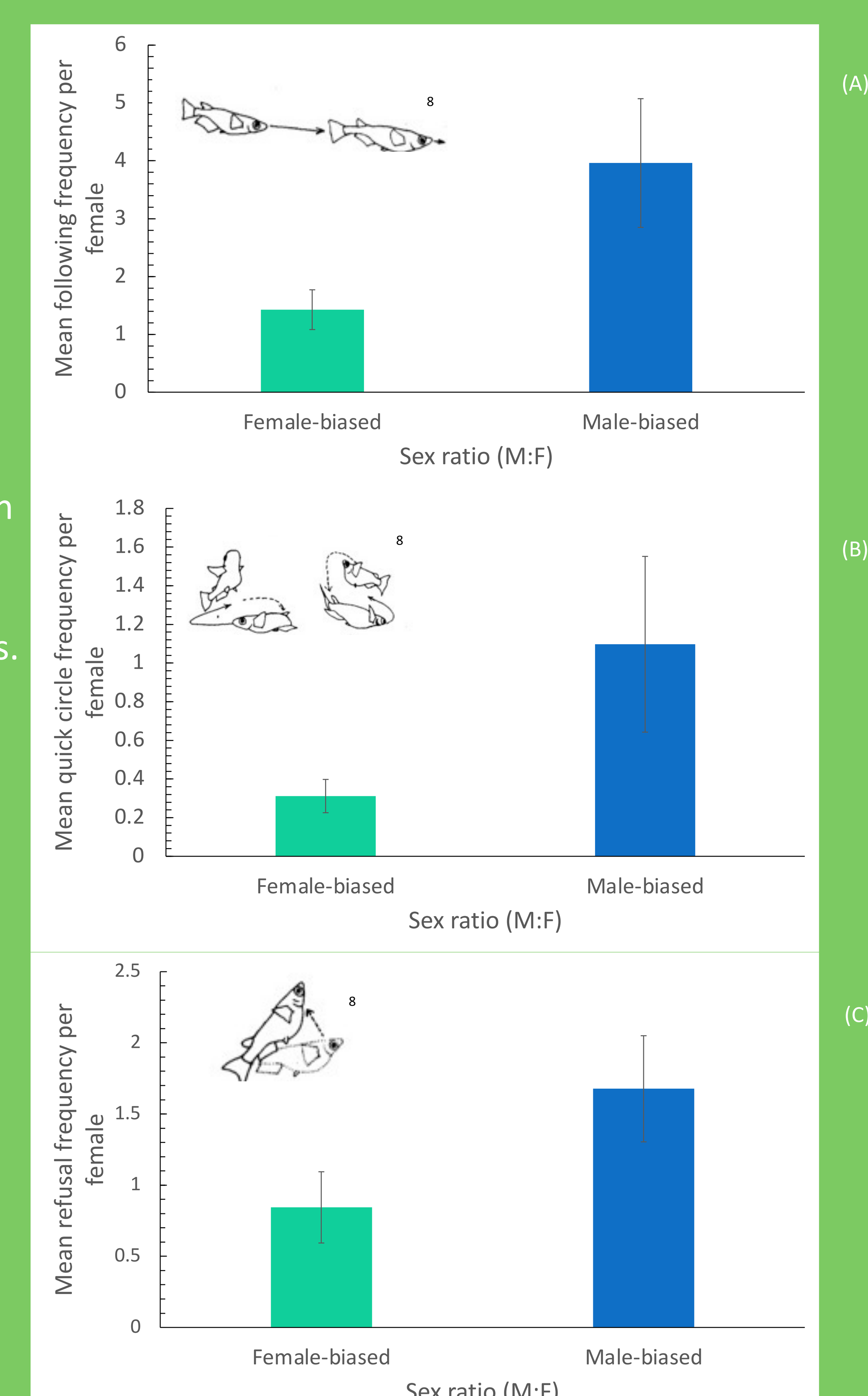
Aggression	Courtship
Male-female chasing	Following
Female-female chasing	Quick circles
	"Head-up" refusal signals

Preliminary Results



No observable difference in M-F chasing per female was found between sex ratios. Observably more F-F chasing per female was found in female-biased sex ratios than in male-biased.

Figure 1. Mean frequencies of aggressive behaviours per female across sex ratios of 0.5 (4 males: 8 females) and 2 (8 males: 4 females). (A) aggressive chasing between males-and females. (B) aggressive chasing between females.



An observable difference in all three courtship ritual behaviours were found between the two sex ratios. Mean following, quick circle and refusal frequencies were all observably higher in male-biased sex ratios than in female-biased ratios

Figure 2. Mean frequencies of courtship and resistance behaviours per female across sex ratios of 0.5 (4 males: 8 females) and 2 (8 males: 4 females). (A) Mean frequency of experienced following per female, (B) Mean frequency of quick circles experienced per female, (C) Mean frequency of "head-up" refusal signals performed per female.

Discussion and Next Steps

1) The lack of observable difference in intersexual aggression between inverse SRs (Fig 1 (A)) may be because males in male-biased ratios are focusing on aggressing against other males rather than wasting time coercing uninterested females. Males did appear to pursue more courtship attempts in male-biased SRs, expressed through a higher rate of following and quick circles received by females in male-biased ratios (Fig 2 (A) and (B)).

2) Females in male-biased ratios exhibit more "head-up" refusal signals (Fig 2 (C)), which may indicate stronger mate choosiness. Females in male-biased ratios have more potential mate options and can afford to be more selective[6]. This increase in courtship attempts by males and the responding increase in the mate selectiveness of females in male-biased SRs may represent increased sexual conflict tensions.

3) Not only did females generally express less courtship resistance, but they exhibited more intrasexual aggression in female-biased SRs (Fig 1 (B)). This aligns with findings from Grant and Foam (2002) that females become more aggressive in female-biased SRs. However, females pursue less overall aggression than males in their respective biased ratios[4], as also observed in this study.

The next step in this project is to statistically analyze the temporal occurrences of these behaviours to investigate male-female interactions and the behavioural manifestations of sexual conflict. Additionally, whether males change their courtship pursuits based on whether females have already mated that day will also be statistically analyzed. Future projects could potentially investigate the influence of male and female social hierarchies or the general aggressiveness of individuals on the severity of sexual conflict in Japanese medaka.

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