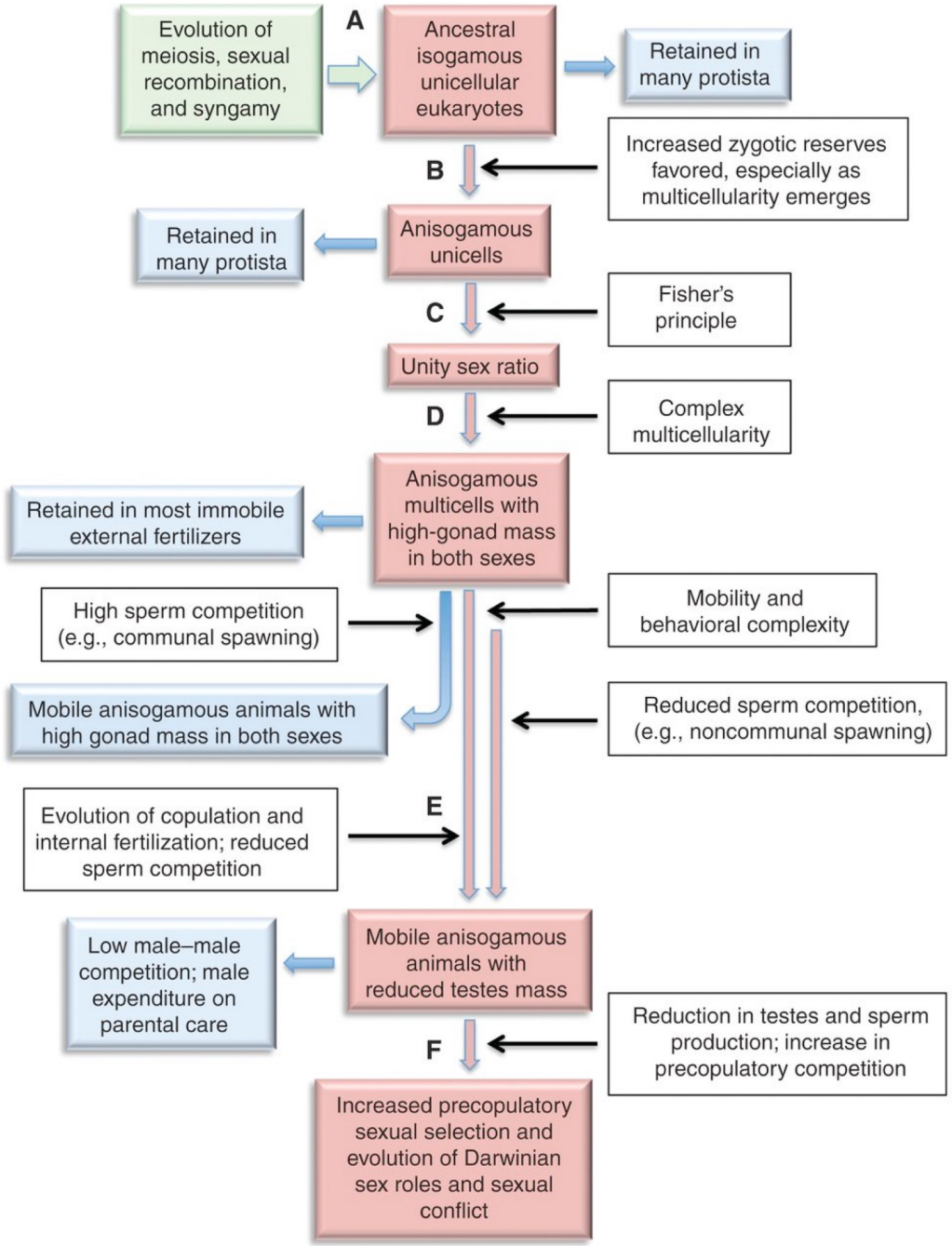
- The form of sexual selection we see today is the result of an inevitable succession of transitions flowing from the early evolution of syngamy to the evolution of copulation and sex roles

- Stages in the cascade should be regarded as consequential rather than separate phenomena and, as such, invalidate much current opposition to Darwin–Bateman sex roles.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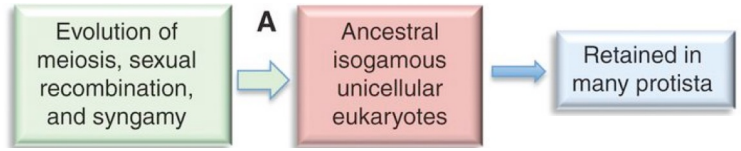
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A: Events Leading to an Ancestral Isogamous Eukaryote

Replicating molecules -> Populations of molecules

Independent replicators -> Chromosomes

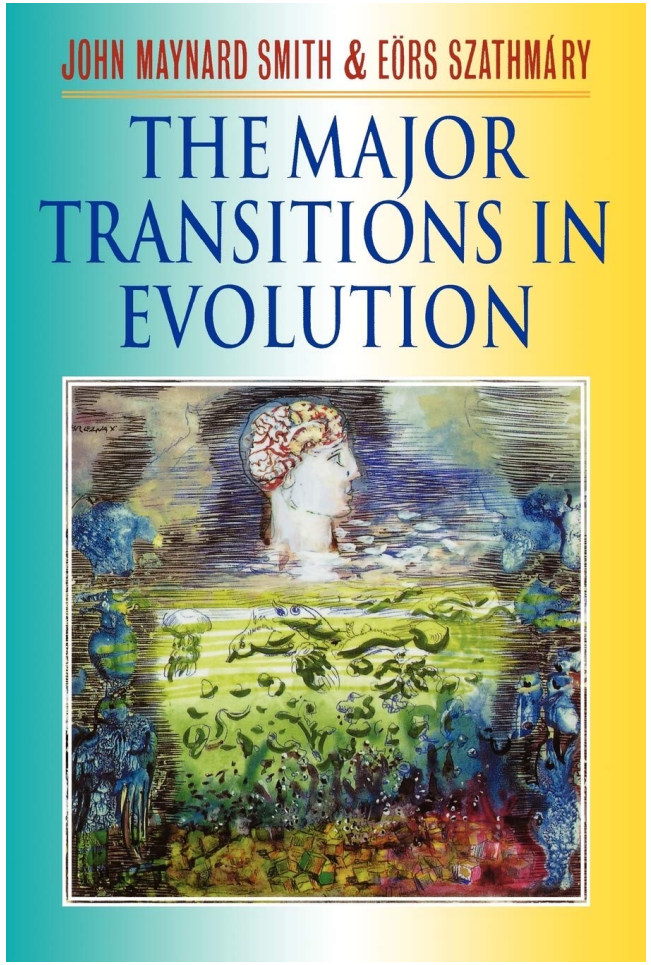
RNA -> DNA

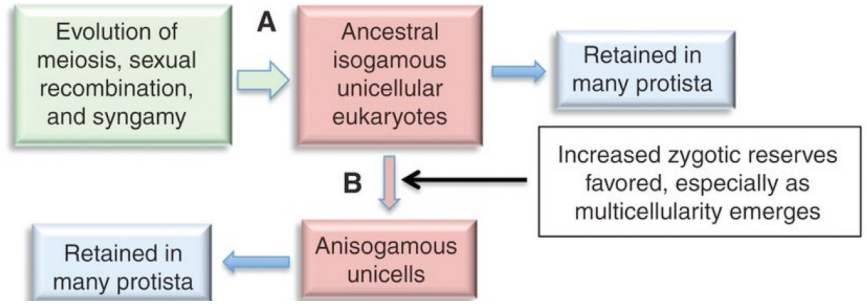
Prokaryotes -> Eukaryotes

Asexual clones -> Sexual Populations

↓

Why a selective advantage of sexuality over asexuality?

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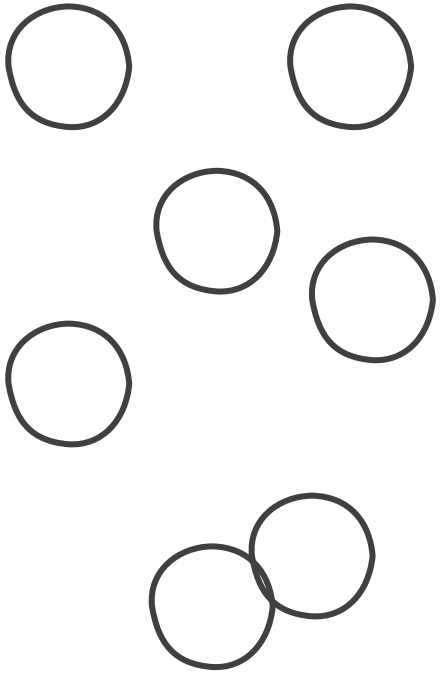
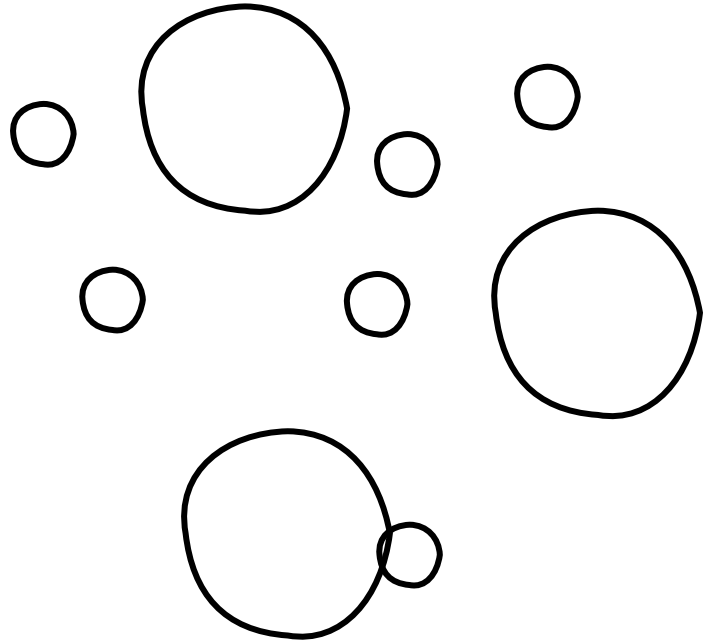
B: Evolution of Gamete Size Dimorphism (Two Sexes)

Isogomous eukaryote



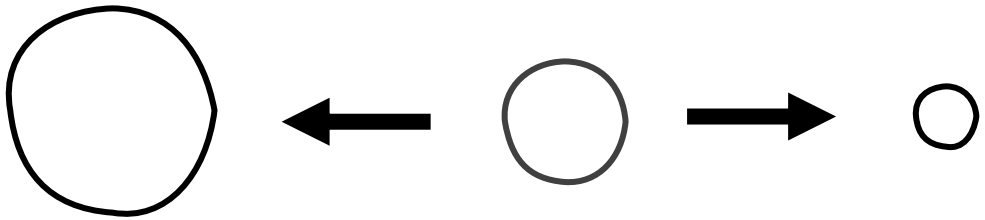
Anisogomous eukaryote



B: Evolution of Gamete Size Dimorphism (Two Sexes)

Bigger is fitter
larger gametes (zygotes) have higher fitness

Higher encounter rates
bigger targets (gametes) are easier to “hit”



Gamete size-number trade-off
smaller gametes are cheaper so more can be made

Motility
smaller things can swim faster

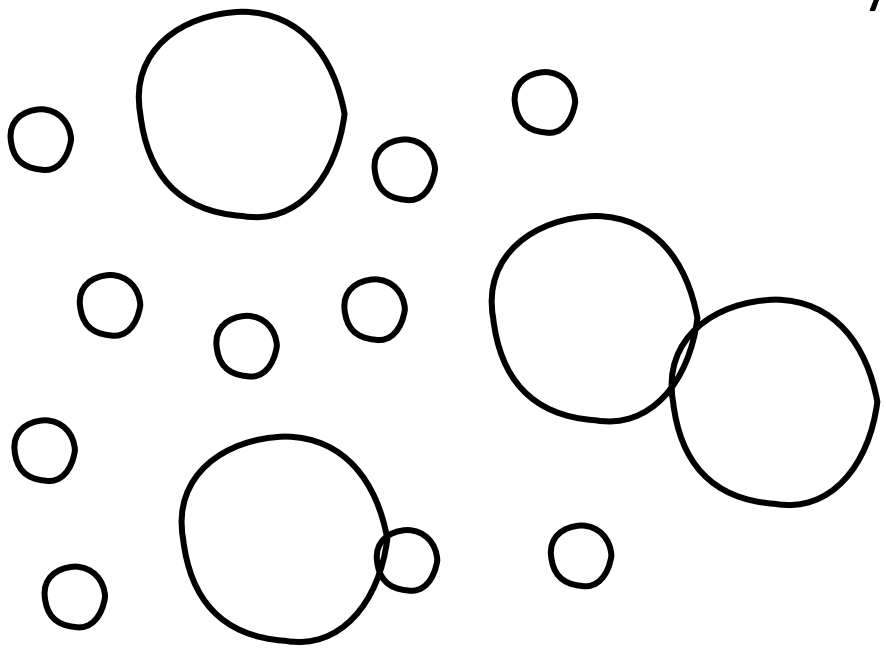
Gamete competition hypothesis

Gamete limitation hypothesis

Assumption
trade-off between size and number of gametes

B: Evolution of Gamete Size Dimorphism (Two Sexes)

Anisogomous eukaryote

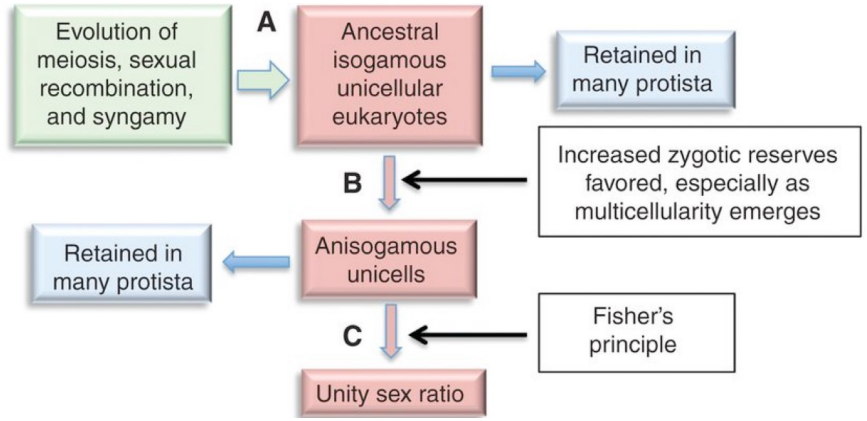


Zygote fitness ~ zygote size

Why do sperm stick around?

1) Mutational advantage in coevolutionary battles

2) If SS fusion is non-viable, stronger selection to avoid SS fusion on sperm, than on Ova to avoid OS fusions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Unity sex ratio

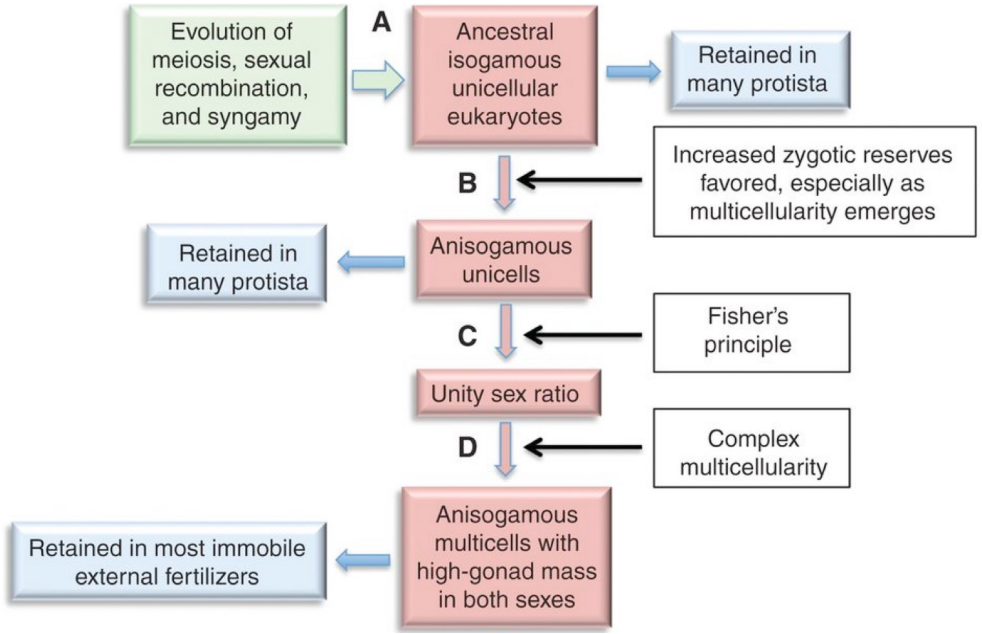
C: Evolution of the Unity Sex Ratio

Under gonochorism
Sex functions are in separate individuals

Fisher's principle applies
Maintenance of a 1:1 sex ratio

1) in sessile or weakly mobile *external fertilizers*,
numerous sperm must compete for rare ova

2) *in internal fertilizers*, if males have less "time out of the mating pool" than females, males must compete for matings with females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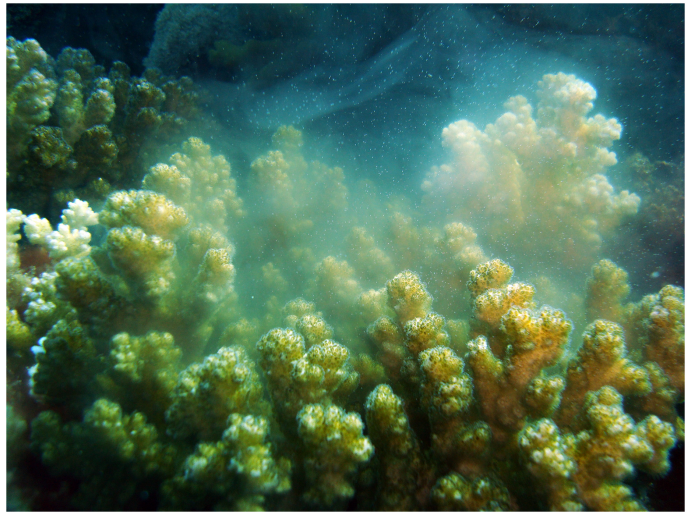
Retained in most immobile external fertilizers

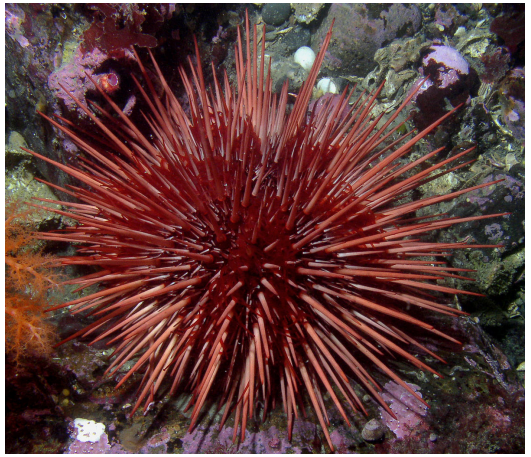
D: Sperm Competition and Evolution of Complex Organisms with High Gonad Mass

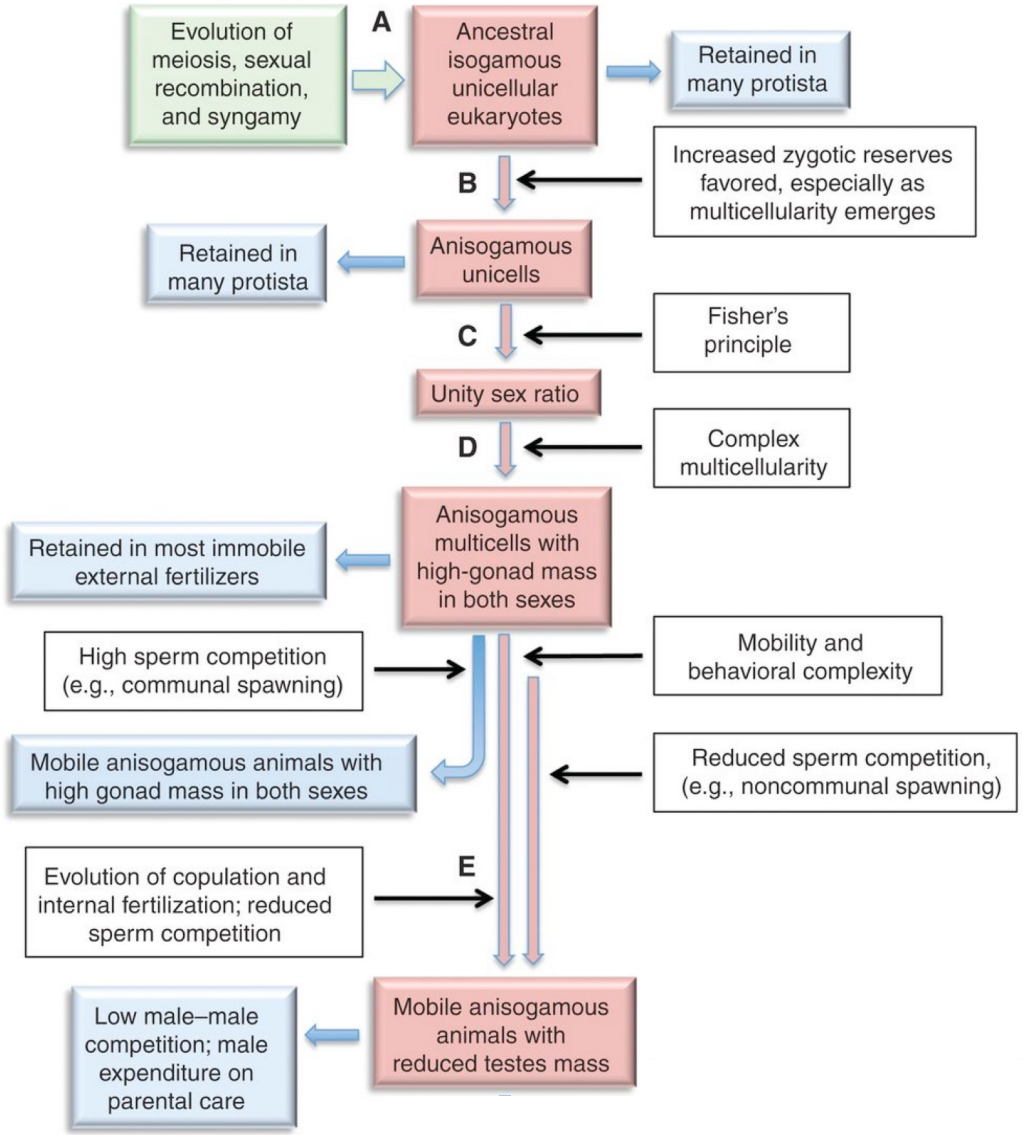
Ways to increase reproductive success if you can't move?
make more gametes

How to make more gametes?
Higher % of body mass as gonad mass



"sexual selection is essentially postejaculatory and sexual conflict relates mainly to fertilization conflicts"

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E: Mobility/Behavioral Complexity and Evolution of Reduced Sperm Competition

1)
weakly mobile ancestor
broadcast spawning w/ **high gonad mass** in both sexes
sperm limitation is common

2)
weak mobility permits and favors aggregation for synchronous spawning to increase fertilization probability for both sexes
sex ratio in spawning aggregations 1:1 because both sexes expend similarly on gametes

E: Mobility/Behavioral Complexity and Evolution of Reduced Sperm Competition

3) mutant males showing **primitive female targeting** are favored because they achieve sperm competition advantages

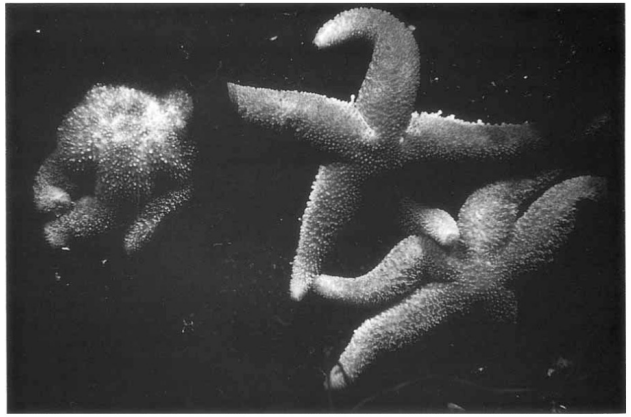
4) as female targeting spreads and becomes more advanced, then, because the sex ratio on spawning grounds is close to unity, **sperm competition decreases as many of the spawnings occur in pairs**.

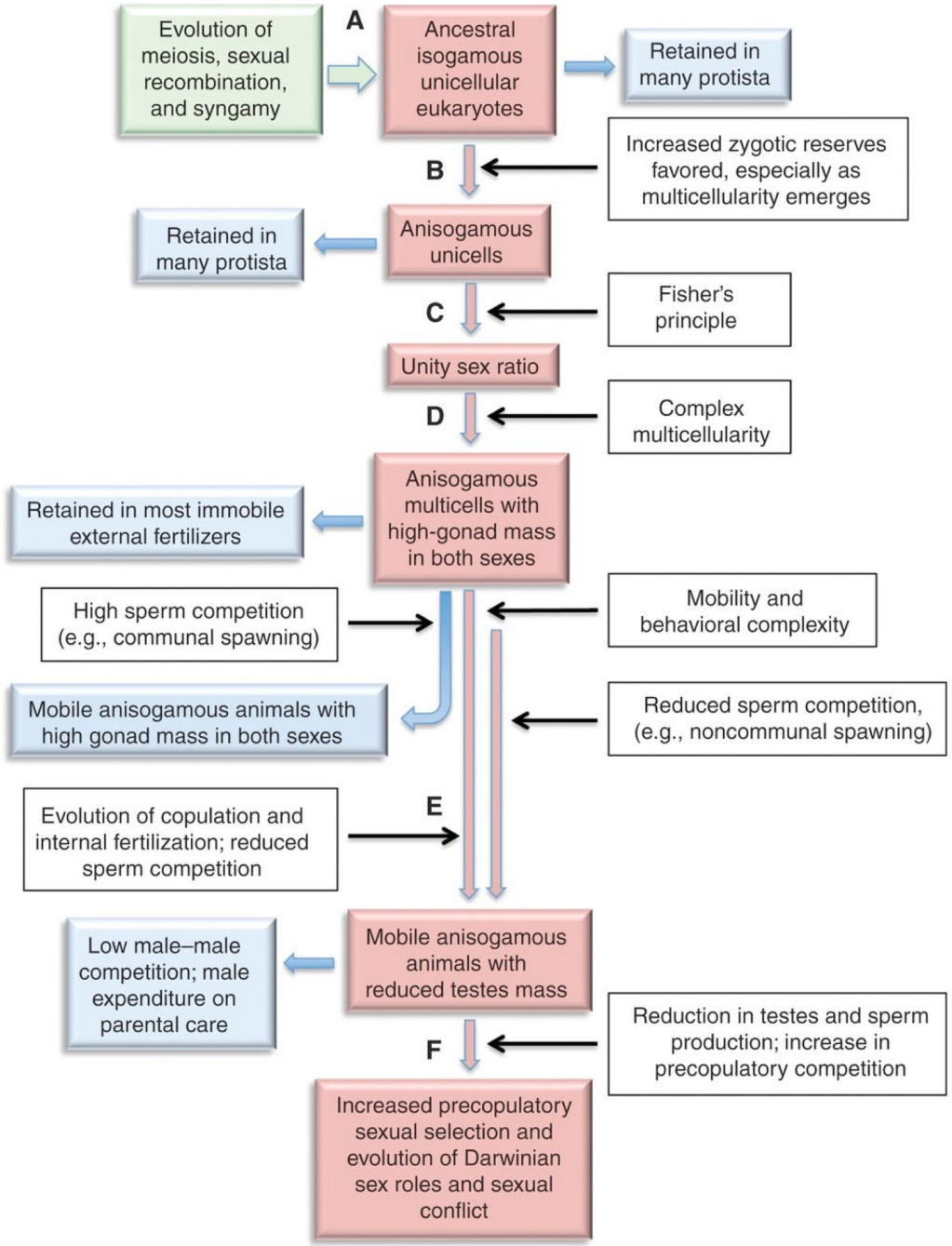
5) close association of the sexes at spawning decreases sperm limitation, reducing the advantage of spawning aggregation and synchrony to females.

E: Mobility/Behavioral Complexity and Evolution of Reduced Sperm Competition

6) female targeting and pre-ejaculatory male competition advance further and **costs to females of aggregation and male harassment favor female dispersion**.

7) this further **decreases sperm competition**, reducing male GSI more and **increasing male expenditure on pre-ejaculatory traits** such as **mate searching** and other forms of **male – male competition**.

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F: The Rise of Pre-Ejaculatory Sexual Selection, Sex Roles, and Sexual Conflict

Sperm competition further decreases
pre-copulatory sexual competition is favoured over sperm production in males

Female gametic expendature remains high
large scope for sexual conflicts

There differences, routed in anisogamy then ultimately give rise to

”Darwinian Sex Roles”

“Reverse sex role” species occur due to ecological or life history conditions
selection cannot drive back to isogamy, but males can evolve parental investment