The fourspine stickleback (*Apeltes quadracus*) has an XY sex chromosome with polymorphic inversions

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Upon formation of a new sex chromosome pair, recombination is often suppressed, leading to subsequent degeneration. Although inversions are proposed to cause recombination suppression on sex chromosomes, there is still little empirical evidence that inversions drive the early stages of sex chromosome evolution. Species with young and polymorphic sex chromosomes might provide insights into the initiation of sex chromosome evolution. To better understand the early evolution of sex chromosomes, we used fourspine stickleback (*Apeltes quadracus*) as a model. Whole-genome sequencing of males and females from three wild populations and genetic crosses from the same populations revealed *A. quadracus* has an XY sex determination system on chromosome 23. Across all three populations, there is a shared 1 megabase (Mb) region of divergence between males and females that contains several novel candidate sex determination genes. However, there are also different patterns of divergence between males and females in each of the three populations. In one population, there is an inversion on the Y chromosome that suppresses recombination between the X and the Y across 8 Mb. In another population, there is an inversion on the X chromosome that suppresses recombination between the X and the Y across 4 Mb. Although there is not extensive degeneration, these recent inversions are associated with the accumulation of premature stop codons, suggesting that degeneration has already begun on these young sex chromosomes. Our results therefore provide an opportunity for further investigation of the role of inversions in the early stages of sex chromosome evolution.