

I have my notochord but where did I leave my tail?

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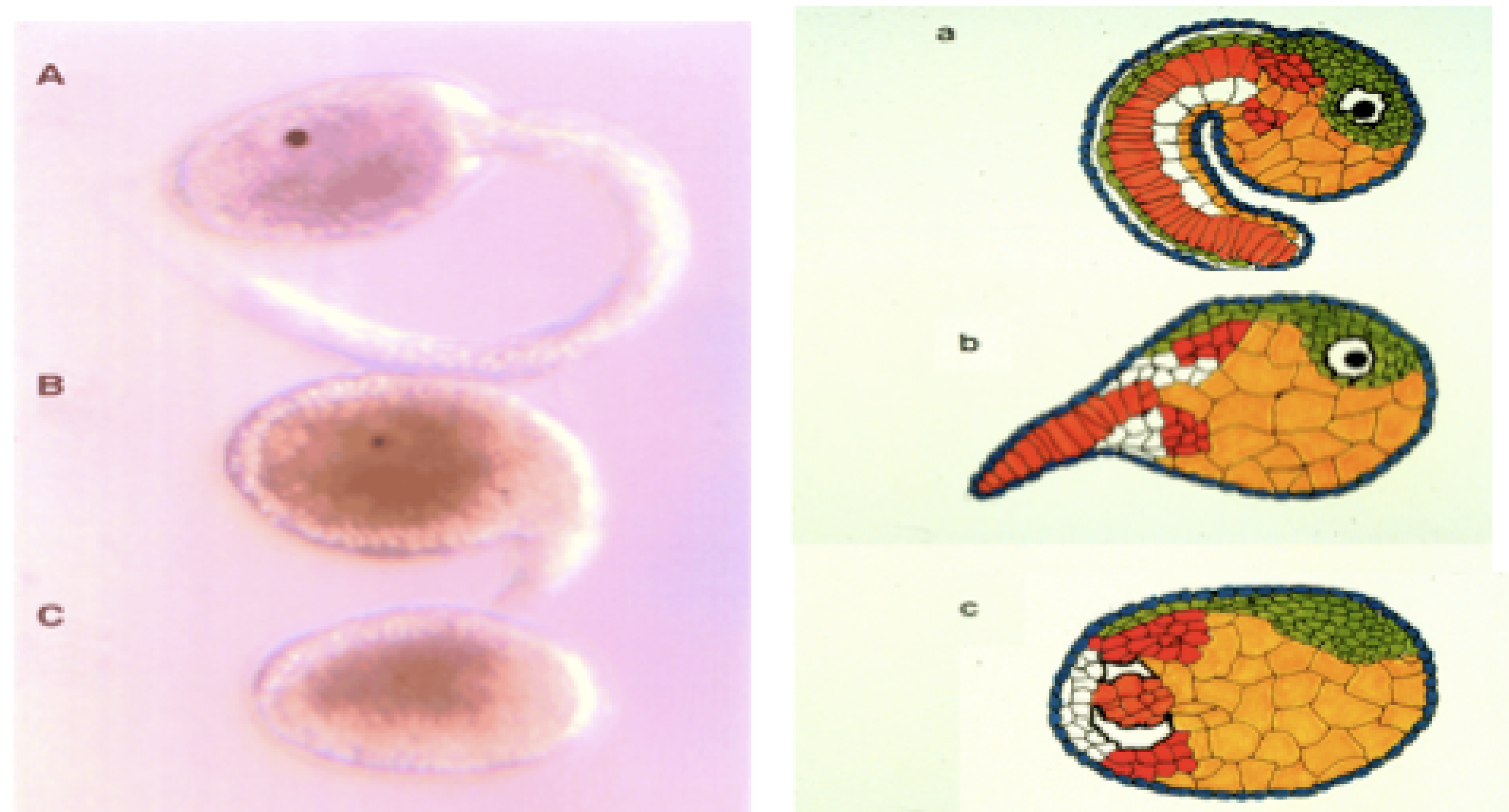
Abstract

In the molgulid clade of ascidians several species have individually evolved tail loss during their larval stage of development. The notochord, one of the key features of chordates, is found in the center of the tail in most ascidian larvae. In almost all solitary ascidians, including *M. oculata*, 40 notochord cells have been found extended in the tail. However, in a closely related species, *M. occulta* (tailless), only 20 notochord cells were found, and these express *brachyury*. These two species are only 3% divergent and are able to cross hybridize. Some of the hybrid also have 20 notochord cells, however the notochord cells extend and converge in a shortened version of *M. oculata* tail. Through the use of high throughput sequencing technologies and subsequent allelotyping analysis, we are able to quantitatively investigate the express of genes associated with notochord development in the parent species and in the hybrid. Our transcriptome assemblies are freely available for download; contact ctb@msu.edu. We thank the BEACON Center and USDA NIFA for funding.

Expression profiles

Gene	Locus	M. oculata (gast.)	Hybrid (gast.)	M. oculata (neur.)	M. oculata (neur.)	Hybrid (neur.)	M. oculata (tailbud)	Hybrid (tailbud)
ATP sulfurylase/APS kinase [Ciona intestinalis]	occulata	0	0	7	0	0	0	0
ATP sulfurylase/APS kinase [Ciona intestinalis]	occulata	17	0	0	13	0	9	0
ATP sulfurylase/APS kinase [Ciona intestinalis]	occulata	117	0	0	103	0	225	104
leprecan [Ciona intestinalis]	occulata	55	0	0	75	0	73	64
leprecan [Ciona intestinalis]	occulata	33	0	0	40	0	67	29
leprecan [Ciona intestinalis]	occulata	0	23	23	0	28	0	36
transcription factor protein foxa-a [Ciona intestinalis]	occulata	37	34	0	43	17	199	141
transcription factor protein foxa-a [Ciona intestinalis]	occulata	0	3	110	0	63	0	0
merlin [Molgula tectiformis]	occulata	0	5	16	0	20	0	10
merlin [Molgula tectiformis]	occulata	0	23	29	0	6	0	18
merlin [Molgula tectiformis]	occulata	9	0	0	7	0	13	0
merlin [Molgula tectiformis]	occulata	19	0	0	86	0	41	0
fibroblast growth factor 8/17/18 [Ciona intestinalis]	occulata	4	0	0	1	0	20	0
fibroblast growth factor 9/16/20 [Ciona intestinalis]	occulata	12	0	0	12	0	49	0
noto17 [Molgula tectiformis]	occulata	24	0	0	34	0	127	0
noto17 [Molgula tectiformis]	occulata	5	0	0	8	0	39	0
noto6 [Molgula tectiformis]	occulata	0	11	11	0	30	0	29
noto6 [Molgula tectiformis]	occulata	10	0	0	18	0	3	0
noto6 [Molgula tectiformis]	occulata	8	0	0	15	0	12	0
prickle 1 [Ciona intestinalis]	occulata	0	193	88	0	90	0	57
prickle 1 [Ciona intestinalis]	occulata	56	0	0	50	0	126	0
prickle 1 [Ciona intestinalis]	occulata	19	0	0	23	0	17	0

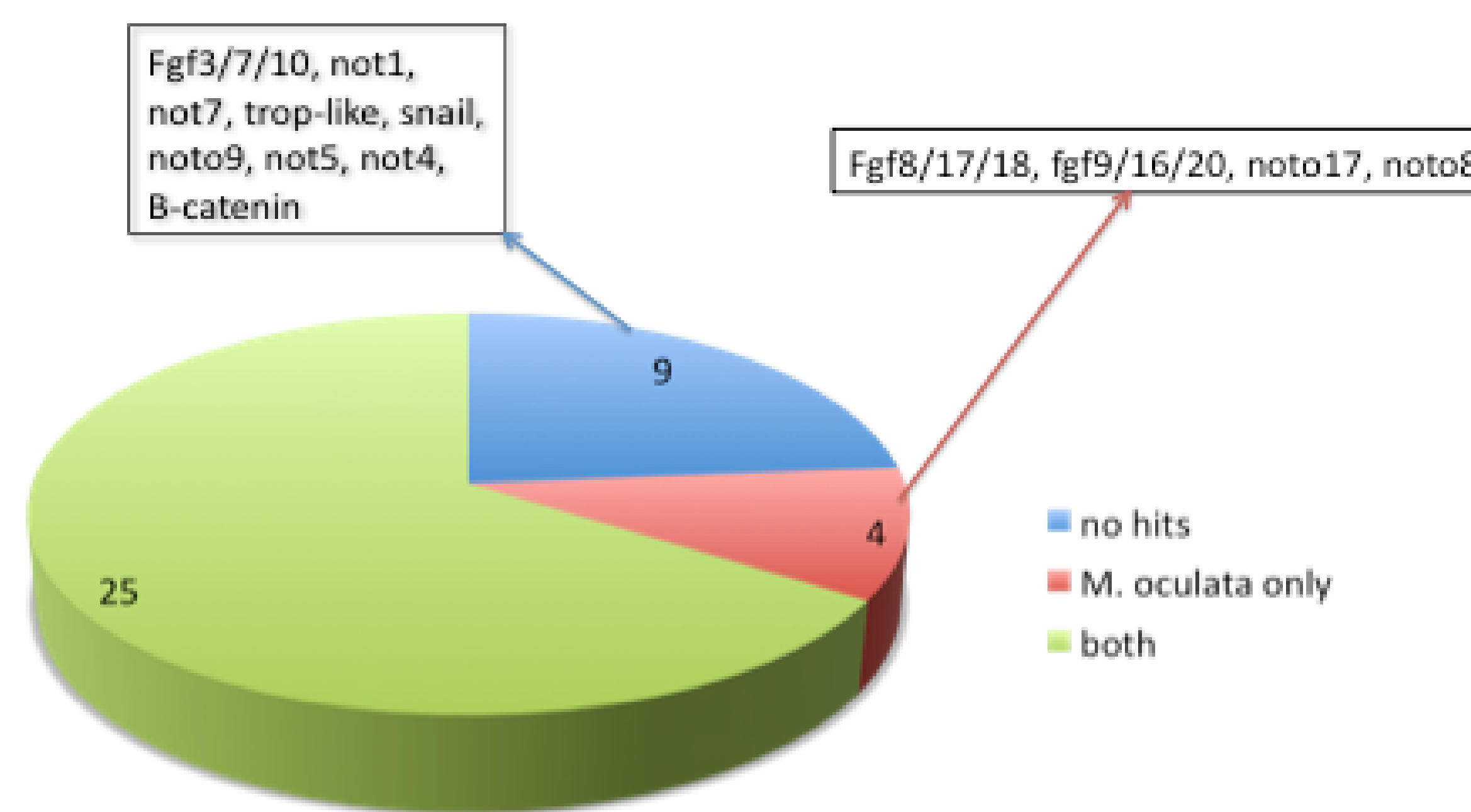
Molgula species studied



a) *M. oculata* b) hybrid (occulata egg x oculata sperm) c) *M. occulta*
 Notochord cells in orange

Swalla, B. et al. Science, Vol 274, Issue 5290, 1205-1208, 15 November 1996

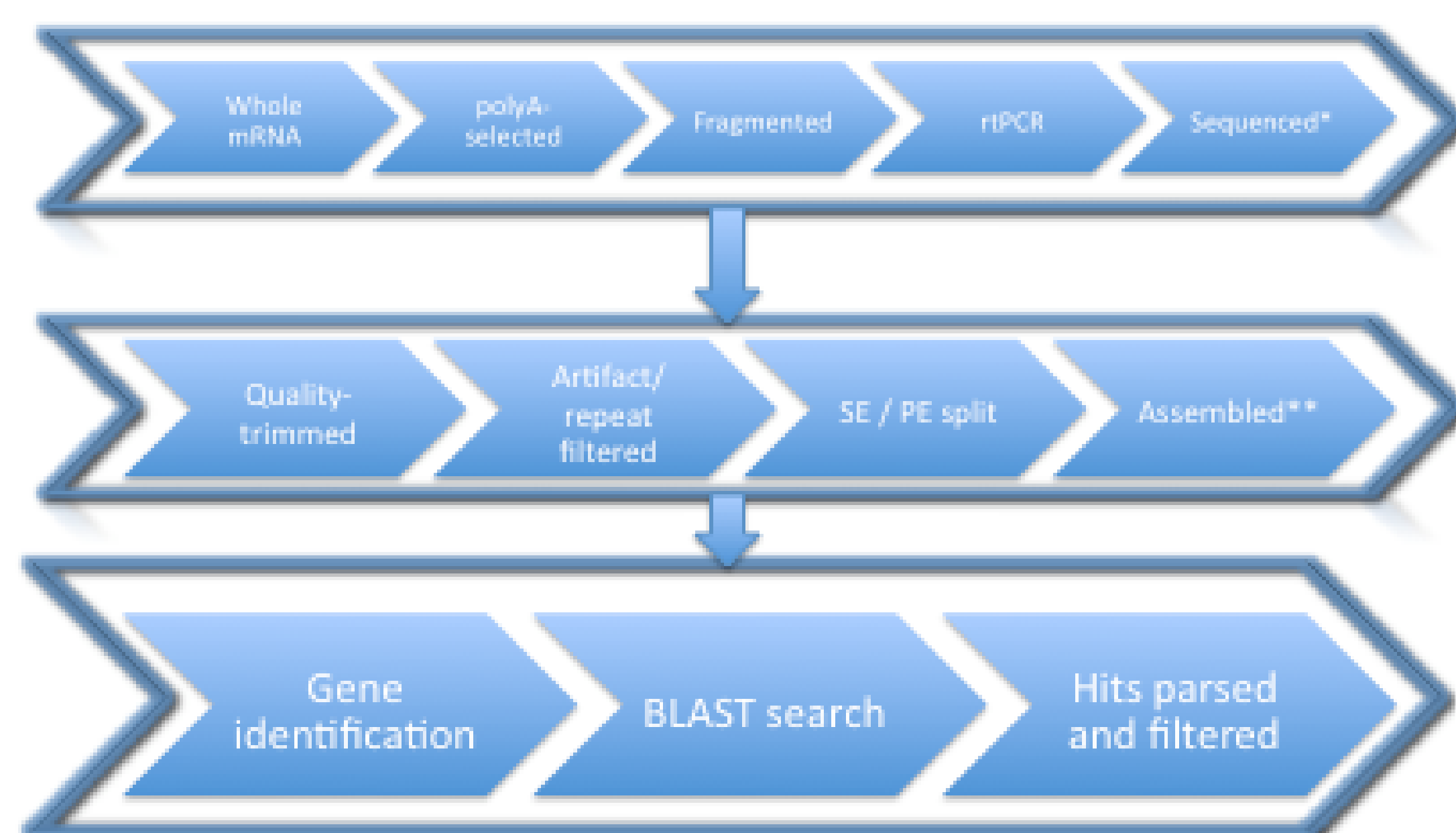
BLAST hits



Discussion

The notochord is important for tail formation. We examined 38 genes associated with notochord development. Of 38 selected, all but 9 were found in either *M. oculata* or *M. occulta*. 25 of the remaining 29 were found in both species, while 4 were found only in *M. oculata*. In the future we plan to confirm gene presence by in situ, increase our query gene set, and examine more time points in *M. occulta*.

Method



*illumina 76 bp x 2, ~250 bp inserts size
 **k = 33

Gene list

- 706e(ki-3)
- ATPcitrate-lyase
- ATPSulfurylase.APSkinase
- Notch
- Mt-merlin
- Mt-noto17
- Not1
- Not2
- Not3
- Not4
- Not5
- Not6
- Not7
- Notch
- beta-catenin
- beta4galactosyltransferase
- Brachyury
- col1
- netrin
- cdc45
- ezrin.radixin.moesin(ERM)-like protein
- fibrinogen-like protein
- Fibroblastgrowthfactor3/7/10/22
- Fibroblastgrowthfactor8/17/18
- Fibroblastgrowthfactor9/16/20
- leprecan
- Mt-noto6
- noto8
- noto9
- pellino
- prickle1
- rel1
- snail
- Suppressor of hairless homolog
- foxa-a
- foxd
- tropomyosin-like protein
- tyrosinephosphatase

Key work cited

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- Imai et al. 2004. Gene expression profiles of transcription factors and signaling molecules in the ascidian embryo: towards a comprehensive understanding of gene networks. Development 131, 4047-4058
- Hotta et al. 2008. Brachyury-downstream gene sets in a chordate, *Ciona intestinalis*: integrating notochord specification, morphogenesis and chordate evolution. Evolution and Development 2008, 10:1, 37-51

Acknowledgements

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