

# On water flow analysis and particle capture in ciliary suspension-feeding scallops (Pectinidae)

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## Animation of gill flow

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The animation shows flow into 2 interfilamental canals in a 2-dimensional model of the symmetric half of funnel formed by 2 plicate gill crests of the scallop *Chlamys varia* (Fig. 1).

The simulation is based on a sequence of frames showing steady solutions to the  $\psi, \omega$ -formulation of incompressible flow in the creeping-flow limit of vanishing Reynolds number.

Steady inflow and outflow are specified according to Fig. 1A, where the width of interfilamental canals and ordinary filaments is  $40 \mu\text{m}$ , half-width of funnel  $80 \mu\text{m}$ , and length of pro-laterofrontal cilia (plfc)  $15 \mu\text{m}$  during active beat and one-half of that during passive beat.

The effect of beating plfc is simulated by specified fluid velocity along each plfc, increasing from zero at

the root to  $U_{\text{tip}}$  at the tip, while the plfc are kept in their fixed  $45^\circ$  positions.

In the sequence of frames, the tip speed  $U_{\text{tip}}$  of plfc-1 to plfc-4 (see Fig. 1A) changes cyclically according to Fig. 2, which shows one full beat period, of which 20% is the active beat where tip speed is estimated to reach  $1 \text{ mm s}^{-1}$ .

The animation consists of 60 frames at 5 fps, lasting 12 s, which should represent a real-time beat period of  $T = 1/f = 1/20 = 0.05 \text{ s}$ , based on a suggested beat frequency of  $f \approx 20 \text{ Hz}$ . The plfc are shown with a solid line during active beat and a dotted line during passive beat. The limitations of the 2-dimensional model should be noted.

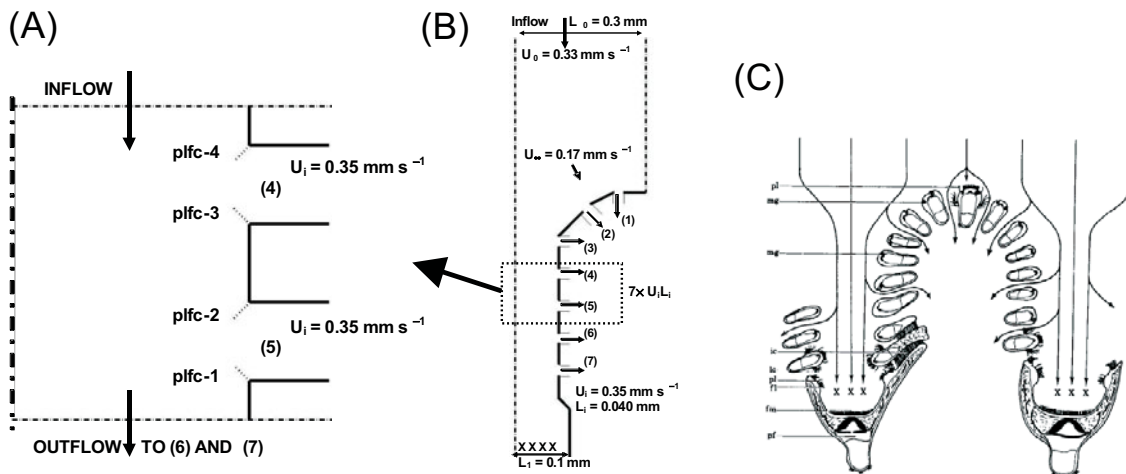


Fig. 1. Computational domain (A) representing flow into 2 interfilamental canals (4) and (5) of model (B) of symmetric half of inter-plicate gill funnel of scallop *Chlamys varia* (C) showing cross section of plicate gill lamella (from Owen & McCrae 1976)

Fig. 2. Relative tip speed of plfc-1 to plfc-4 versus time over one full period of beat. Negative values correspond to active beat

