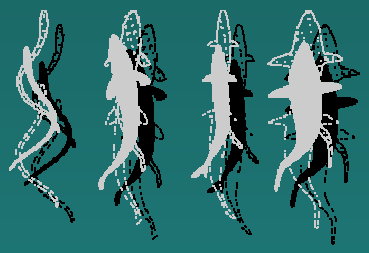


A research project on

Design of a human powered bionic boat

Under the guidance of Prof. V.P.Bapat

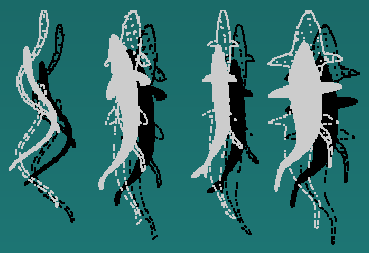
Bionics and boat design

Selecting the mode of locomotion

anguilliform swimming

Suggestion of mechanisms

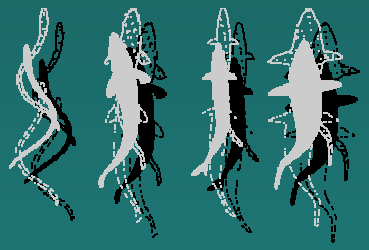
Future prospects



Bionics and boat design

Appreciating God,s creation

Hunch for feasible product

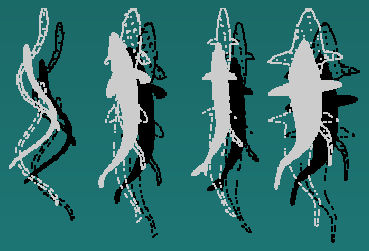


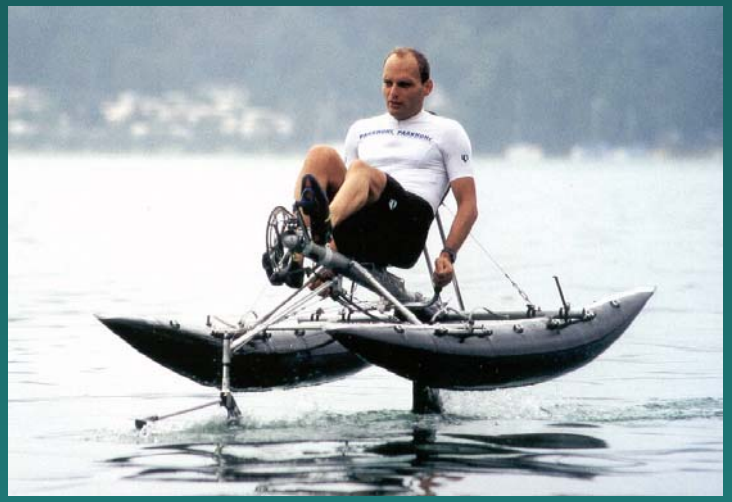
Existing human powered boats

Efficient

Effortless

Refined

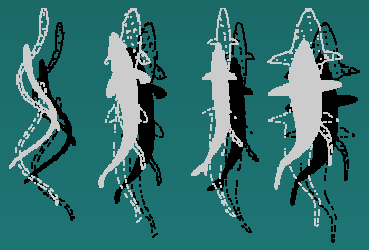




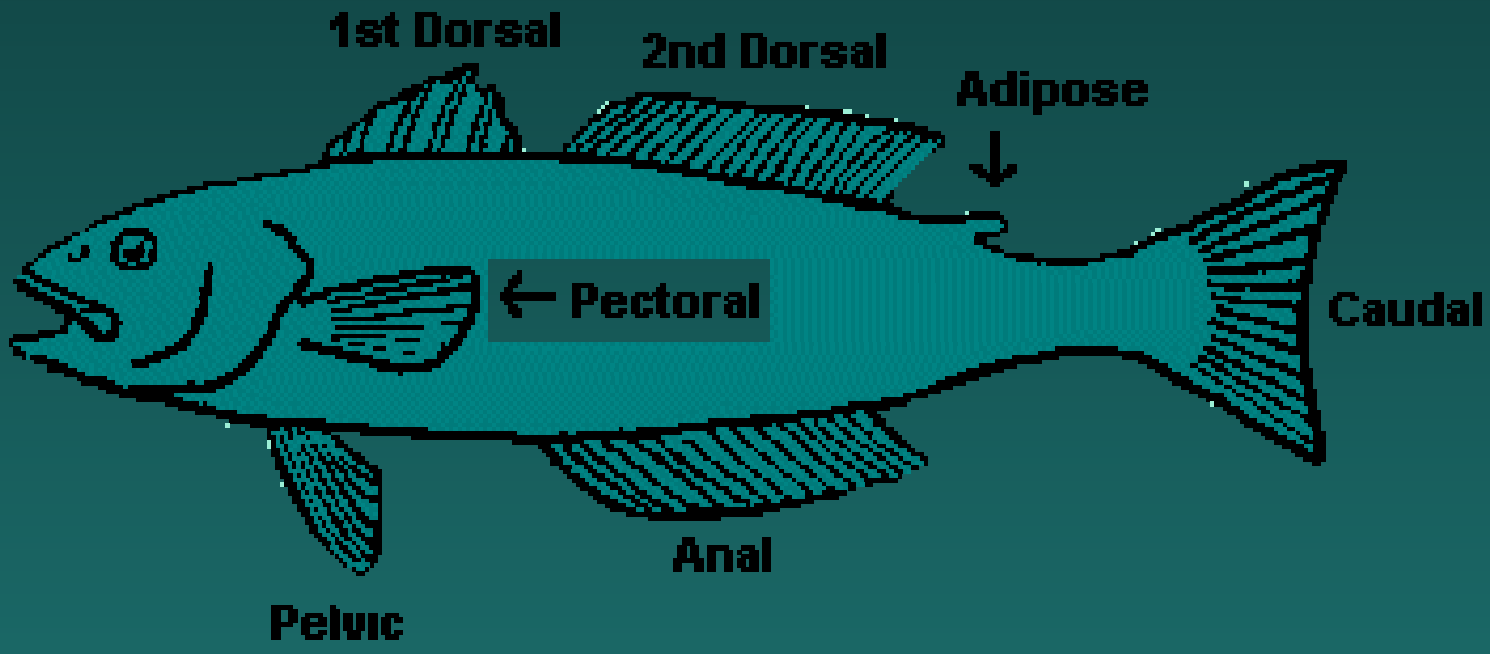
Existing human powered boats

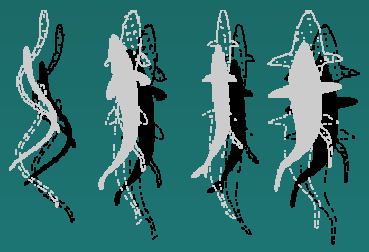
Sports

fun

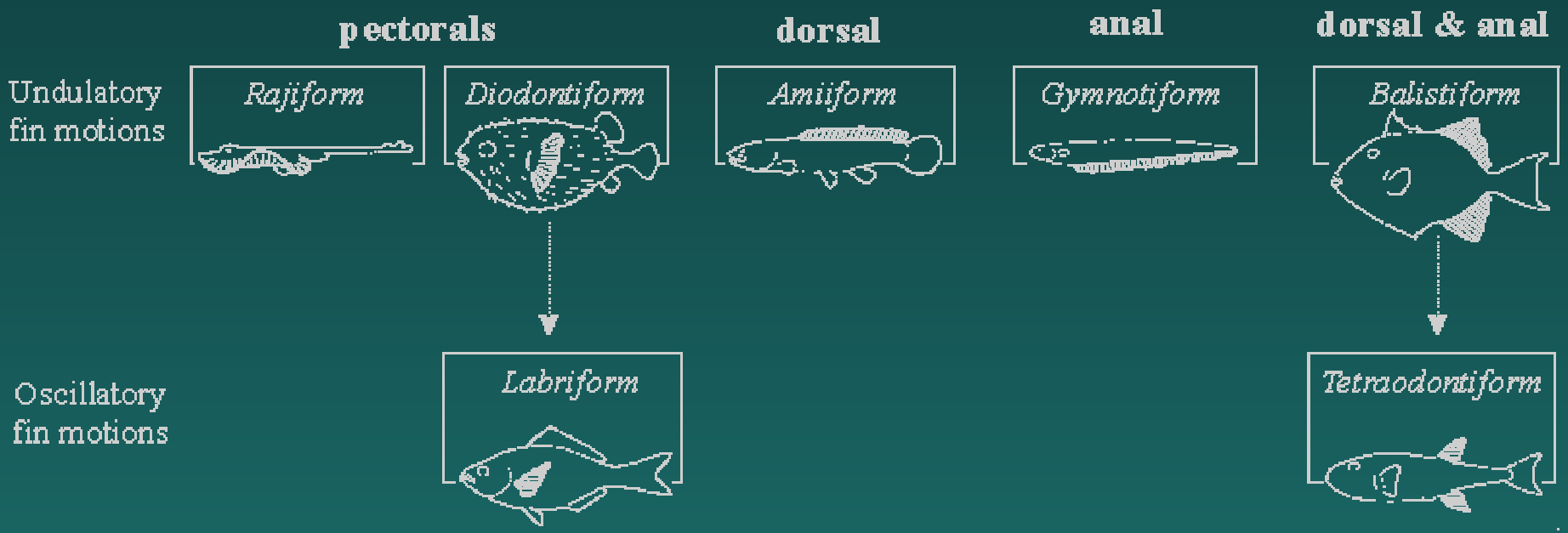


fish

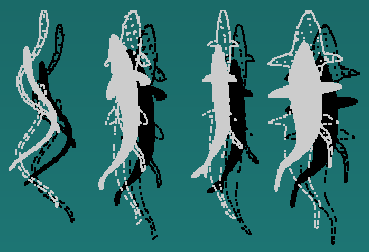




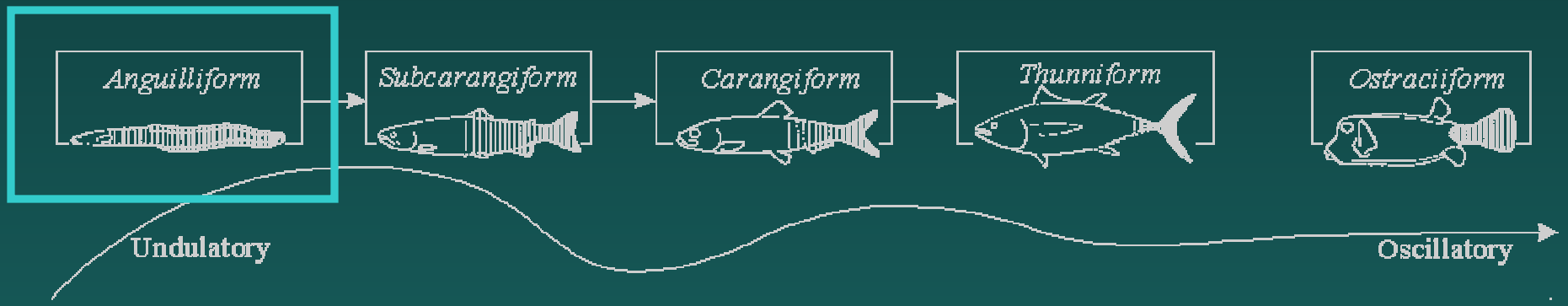
Fish classification

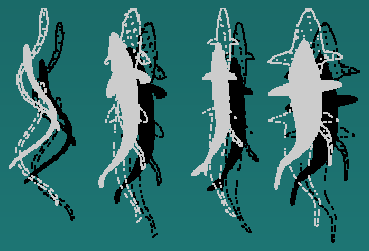


MPF Propulsion (Median/paired fish propulsion)



BCF Propulsion (Body/Caudal Fin propulsion)



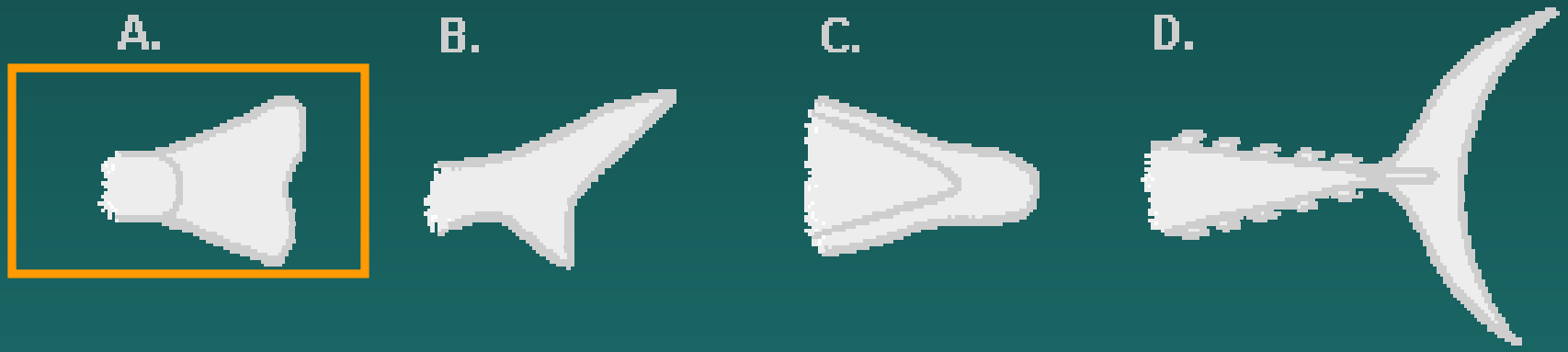


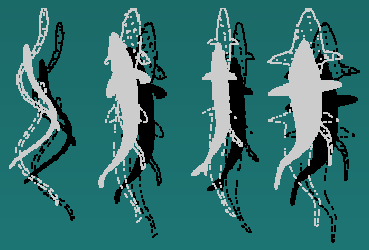
Eel

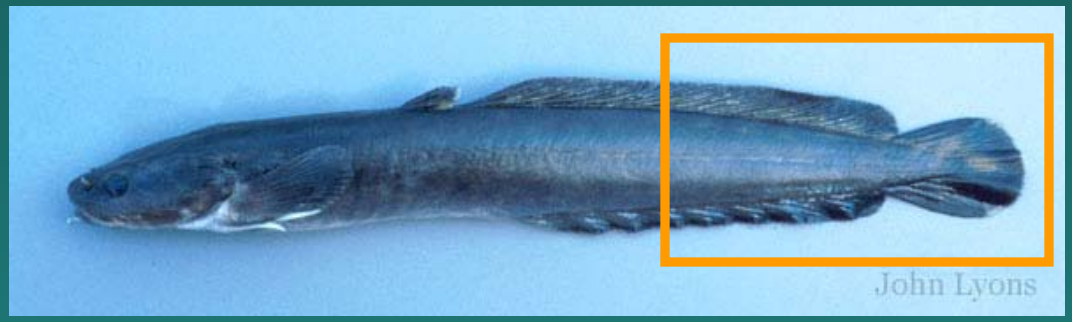
Green moray

Type of fins

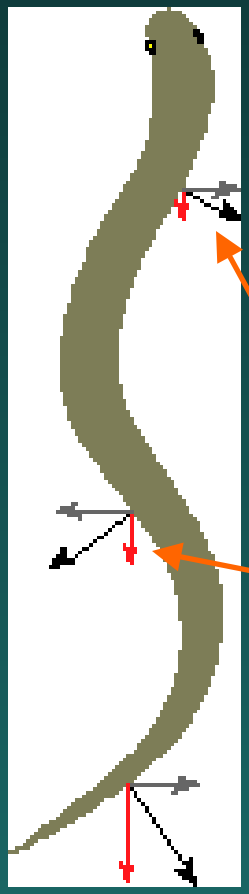
The body is long and thin, while the caudal fin is typically small and rounded, often missing altogether



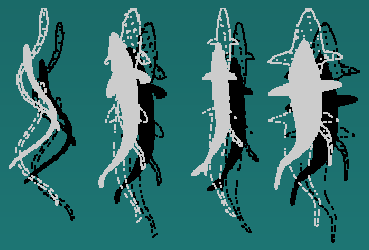




Anguilliform mode of locomotion



Vectors on both sides are cancelled out avoiding any recoil or yaw of the body



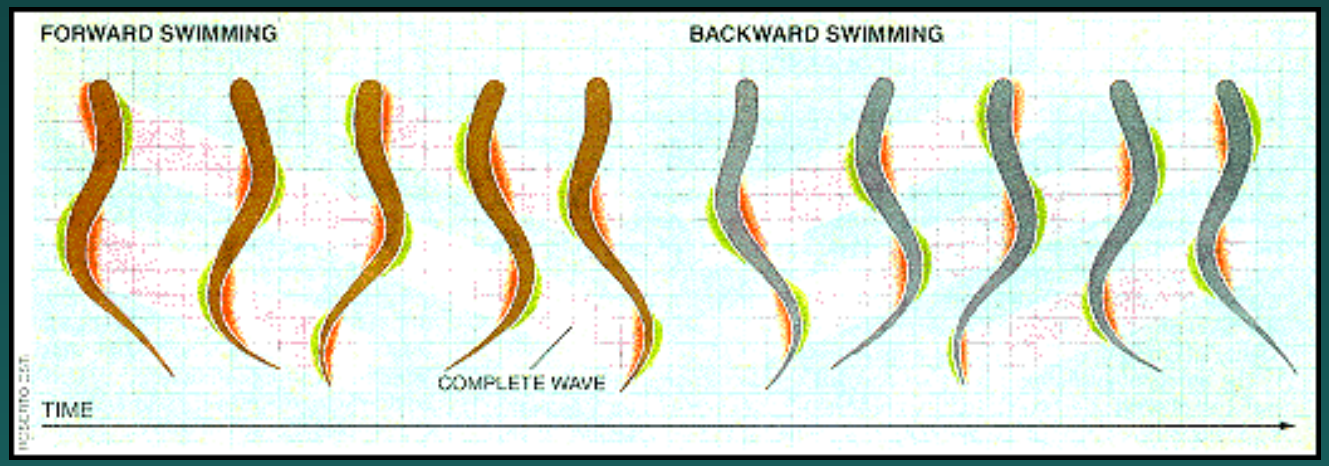
Purely undulatory mode of swimming (whole body participates)

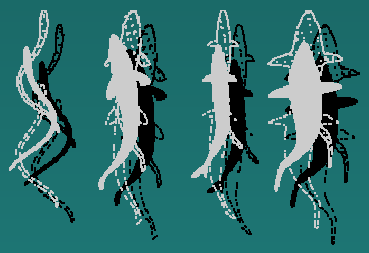
Creates a sinusoidal wave as it swims(at least one wavelength)

Amplitude increases towards the tail

Well developed dorsal fins helps in overall body compression and backward swimming (green morays)

Superiority of anguilliform mode





Swims backward by altering the propagation direction of the propulsive wave (stiff tail)

Good for rapid turns and quick acceleration

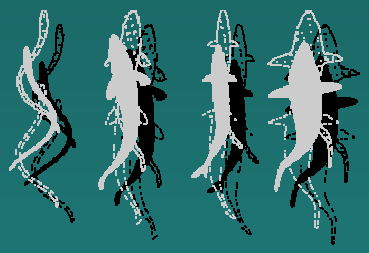
Streamlined flow, less turbulence in the flow c

limitations

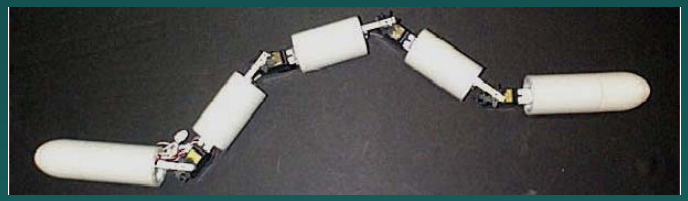
Whole body involved (more drag)

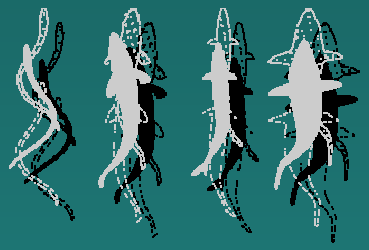
Inefficient braking (slows down)

Not for high speed and cruising



Biomechanics project done on eel





Replication of the movement and form

Similar as that of fish, fully emerged in water

Developed to a real looking eel

Propulsion in anguilliform

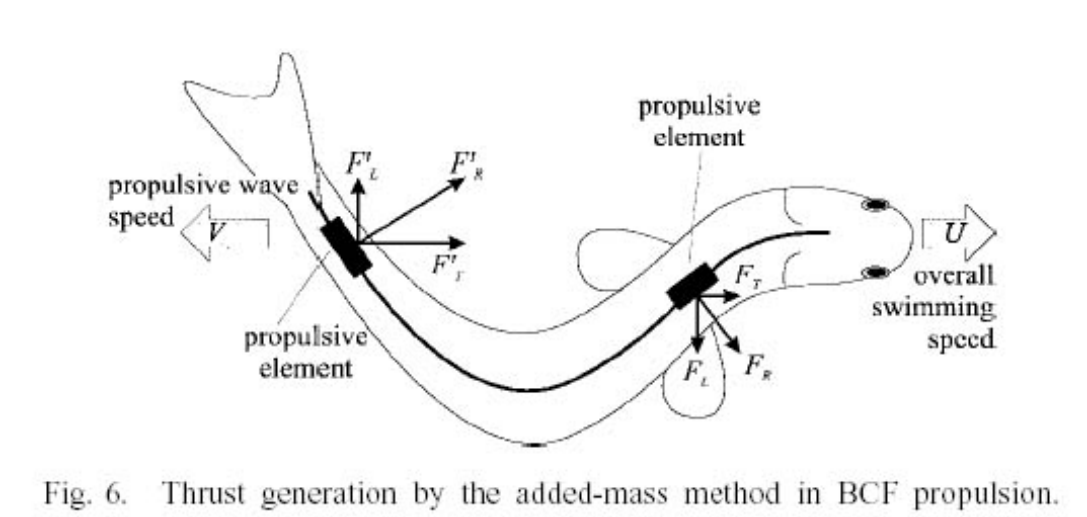
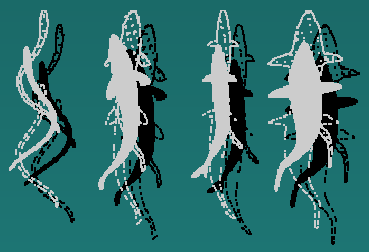


Fig. 6. Thrust generation by the added-mass method in BCF propulsion.



Swimming efficiency

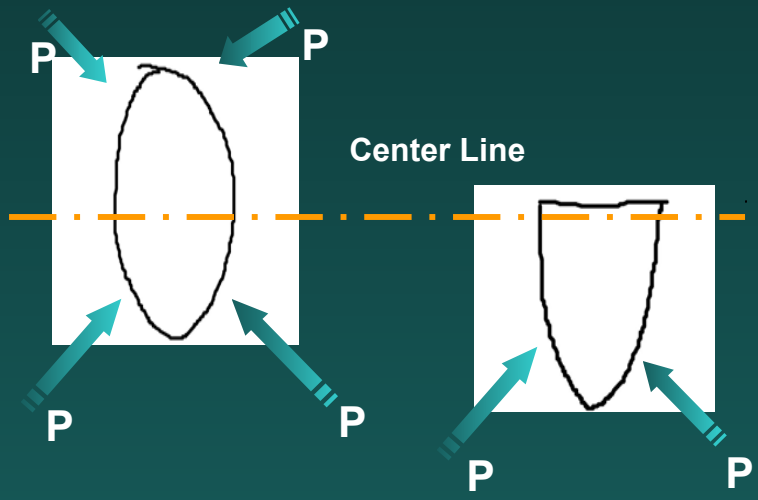
U/V

U = overall swimming speed

V = wave propagation speed

'V' is normally greater than 'U'

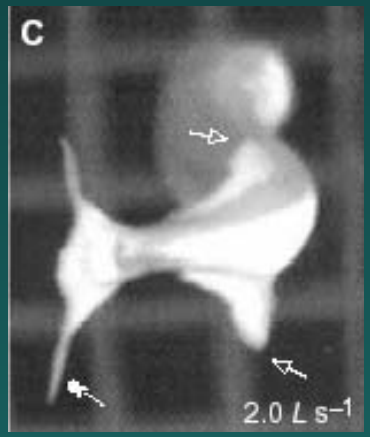
Technical details

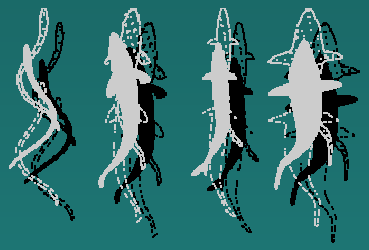


Eel's cross section

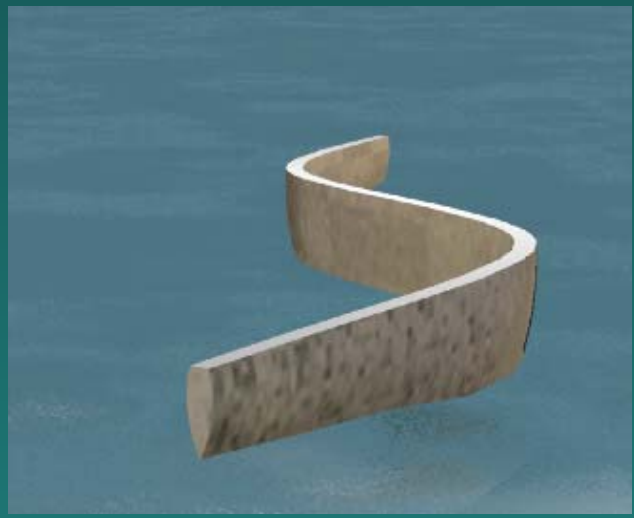
Ideal cross section for our design

Hydrodynamic lift





Elliptical C/S



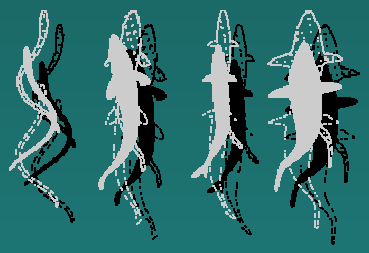
Semi-elliptical C/S

Intention for design

Mechanical advantage for transferring human power into propelling power of the mechanism

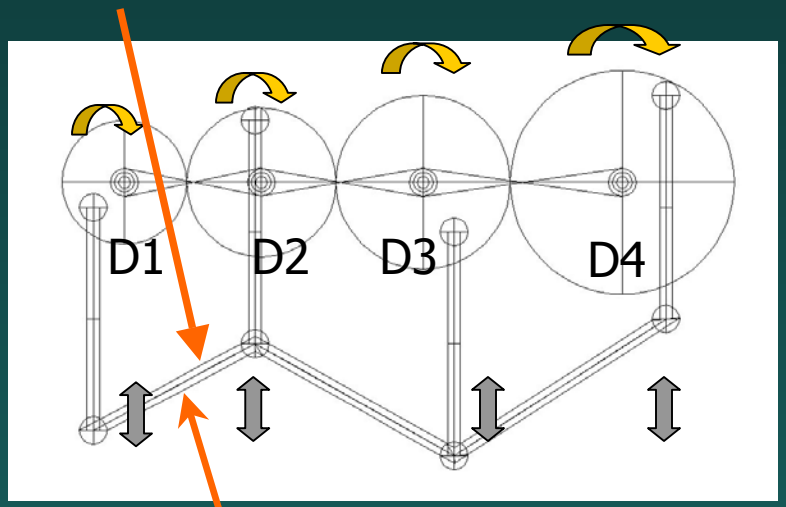
Capturing the bionic action

Simplification of the mechanism



Suggested mechanism

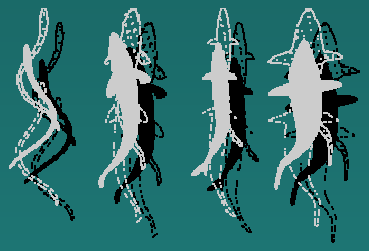
+ve pressure



-ve pressure

Initial concept for creating undulations

RPM is same for all the wheels D1, D2, D3, D4 gives different amplitude

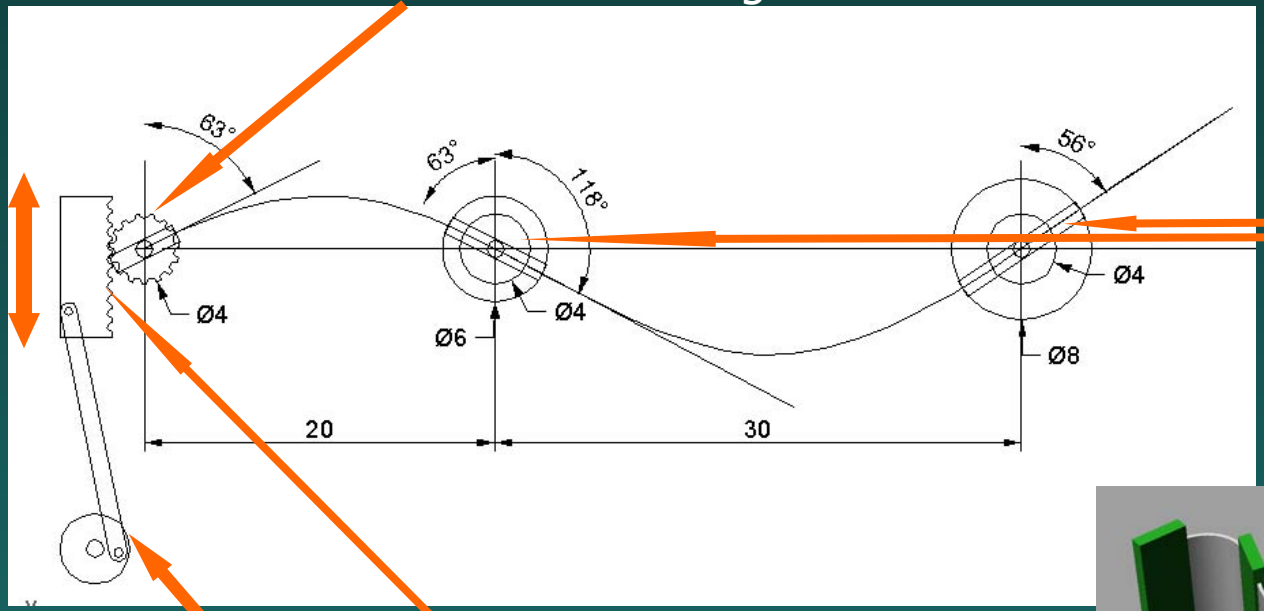


Failed to capture the movement when analyzed critically

1

Suggested mechanisms

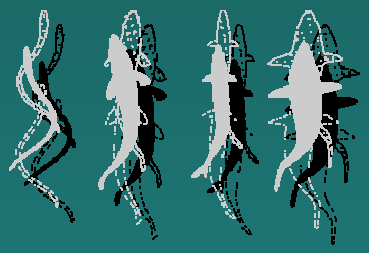
Non slid able hinge



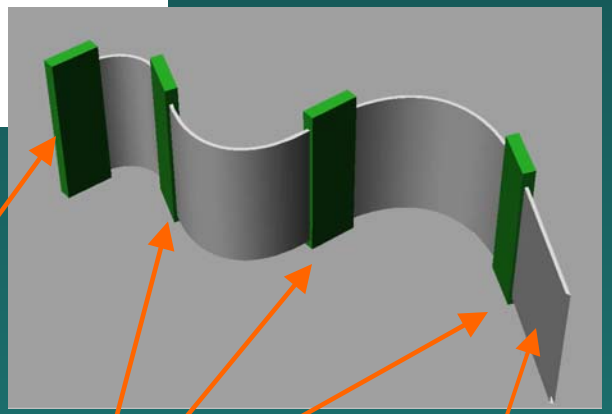
Slid able hinge

Rack and pinion

Rotary to reciprocation motion



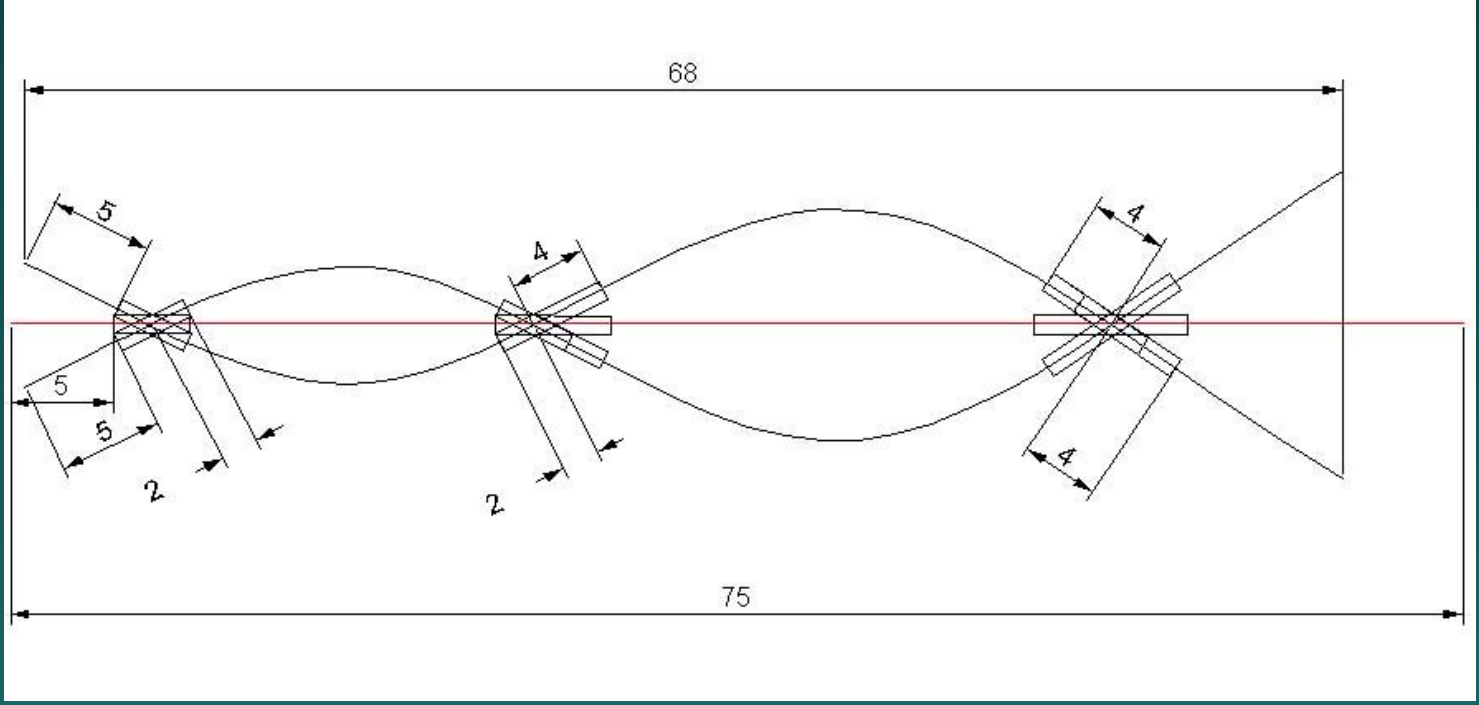
Fixed

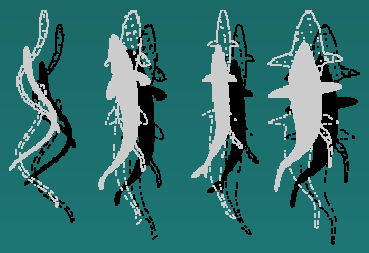


Slid able

Flexible steel plate

Finer details

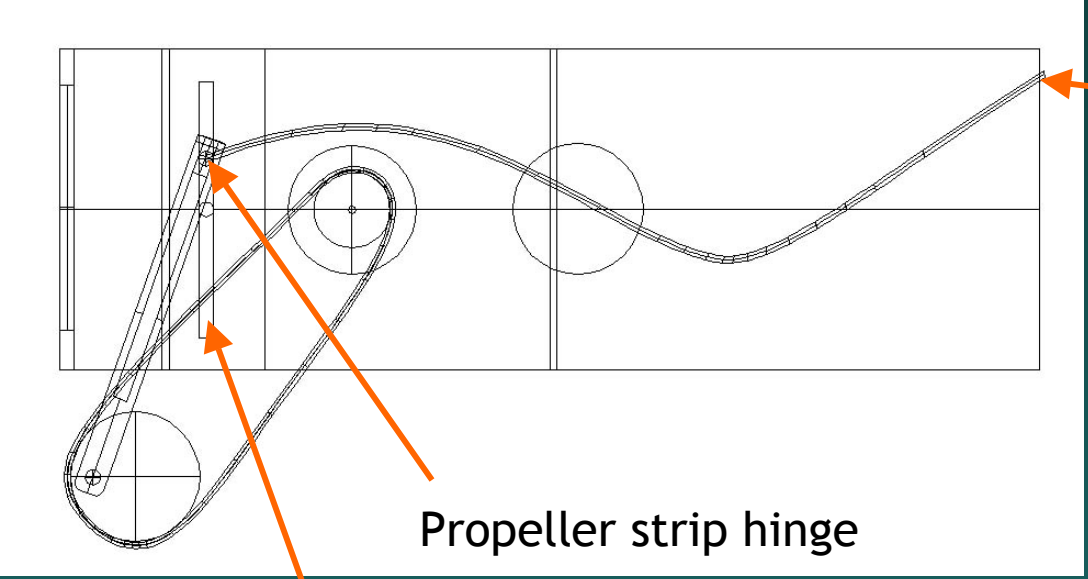


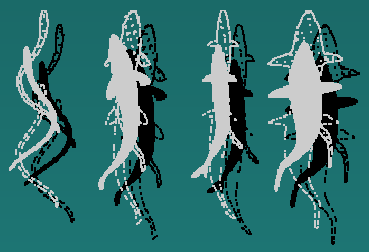


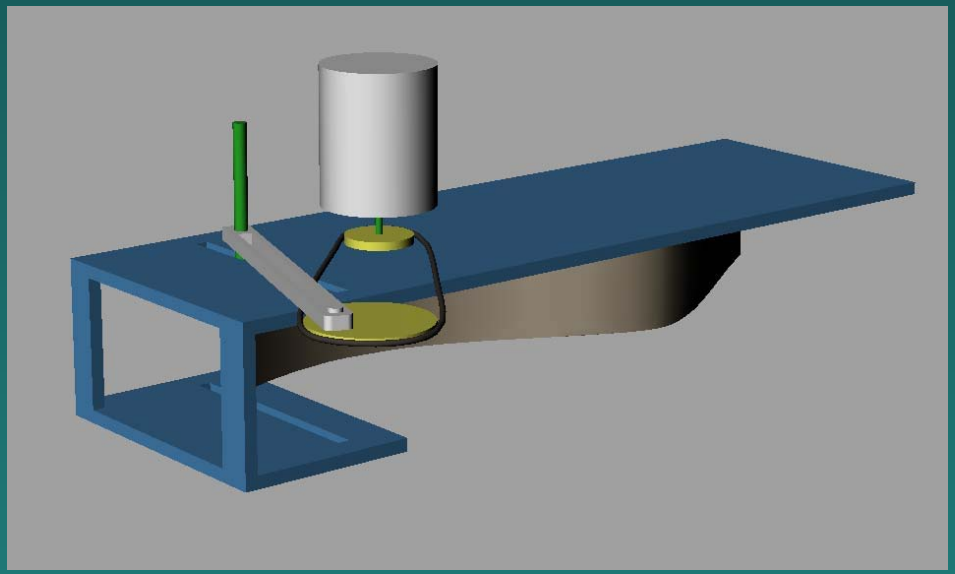
To achieve progressive propulsive sinusoidal wave

Failed – intermediate nodes between two nodes restricts progressive wave generation

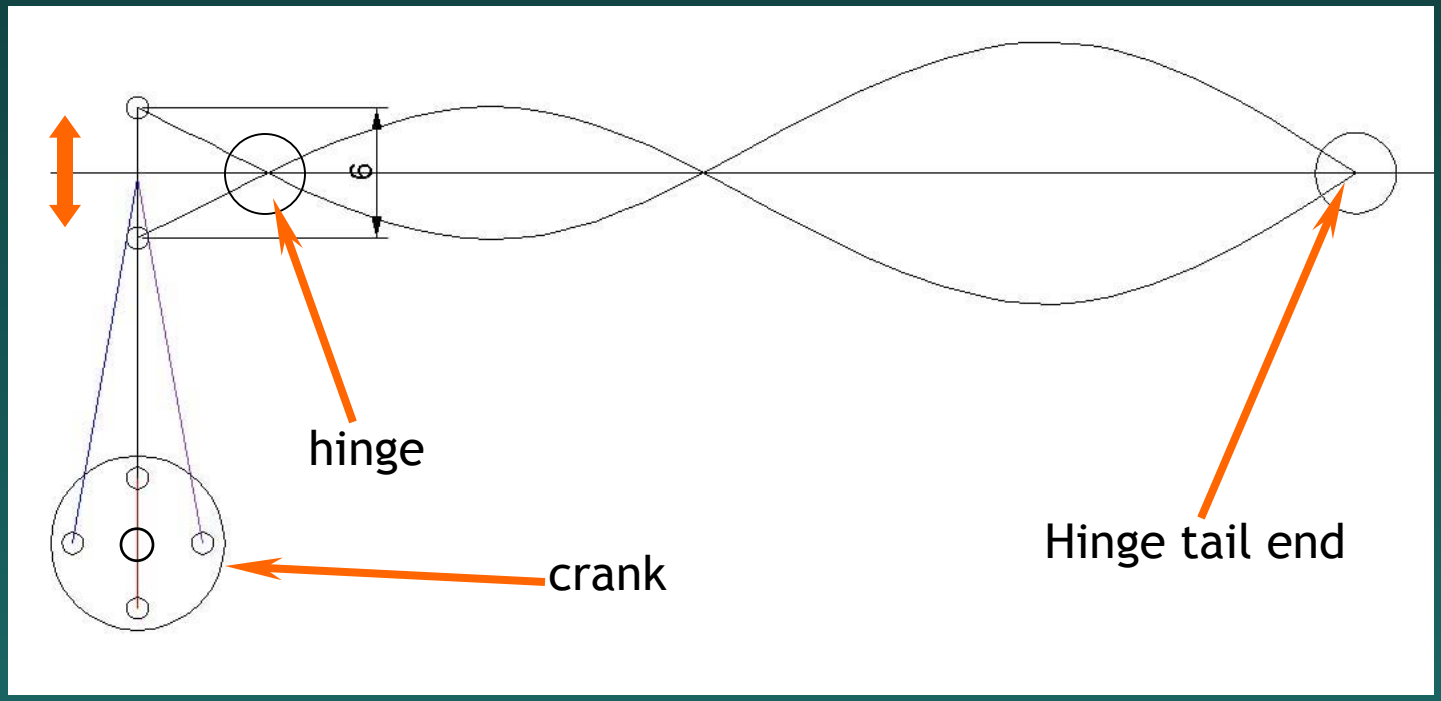
2

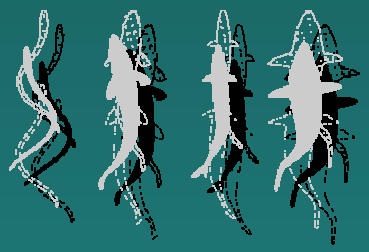

Loose end of the propeller
Propeller strip hinge
Sliding slot





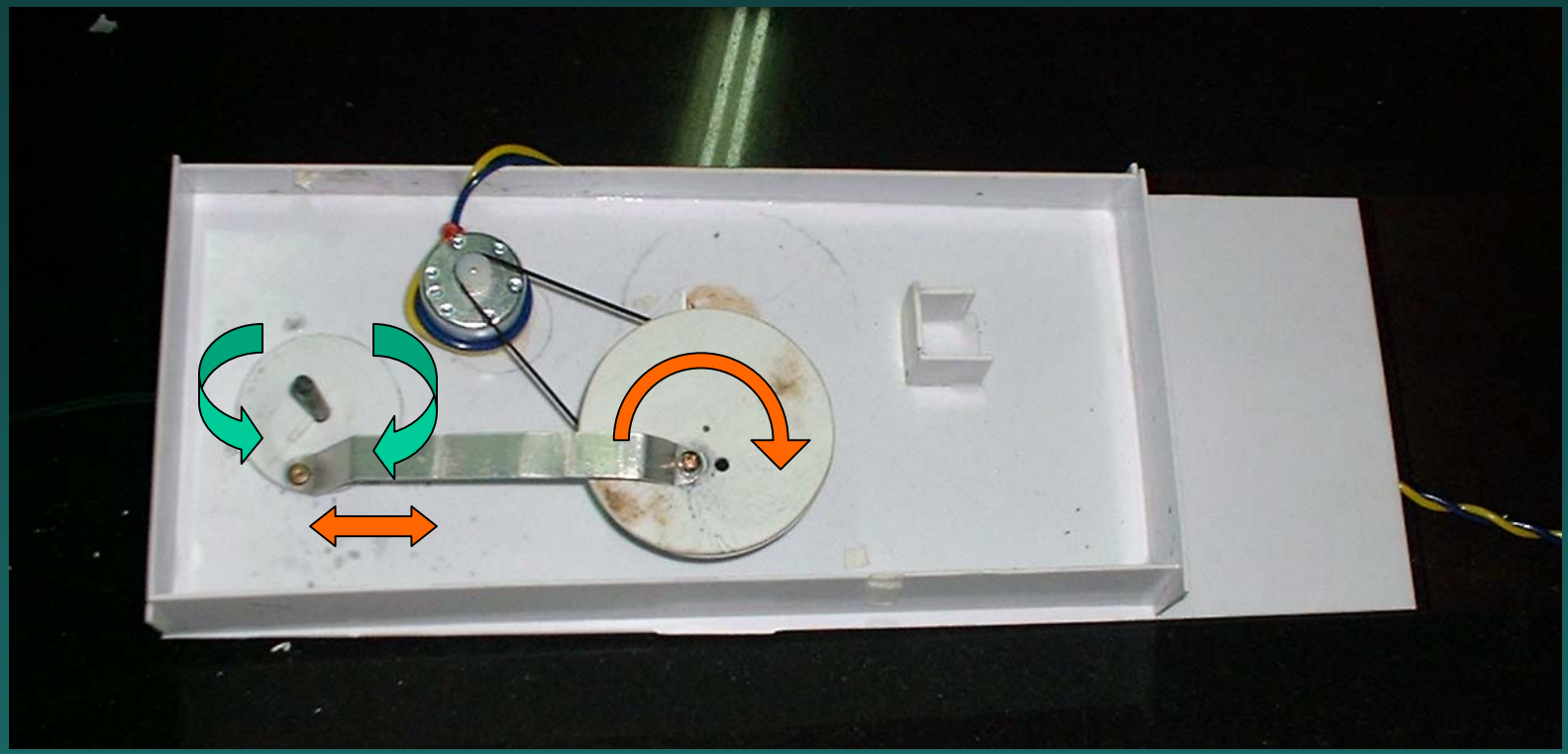
3

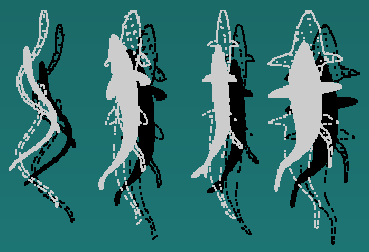




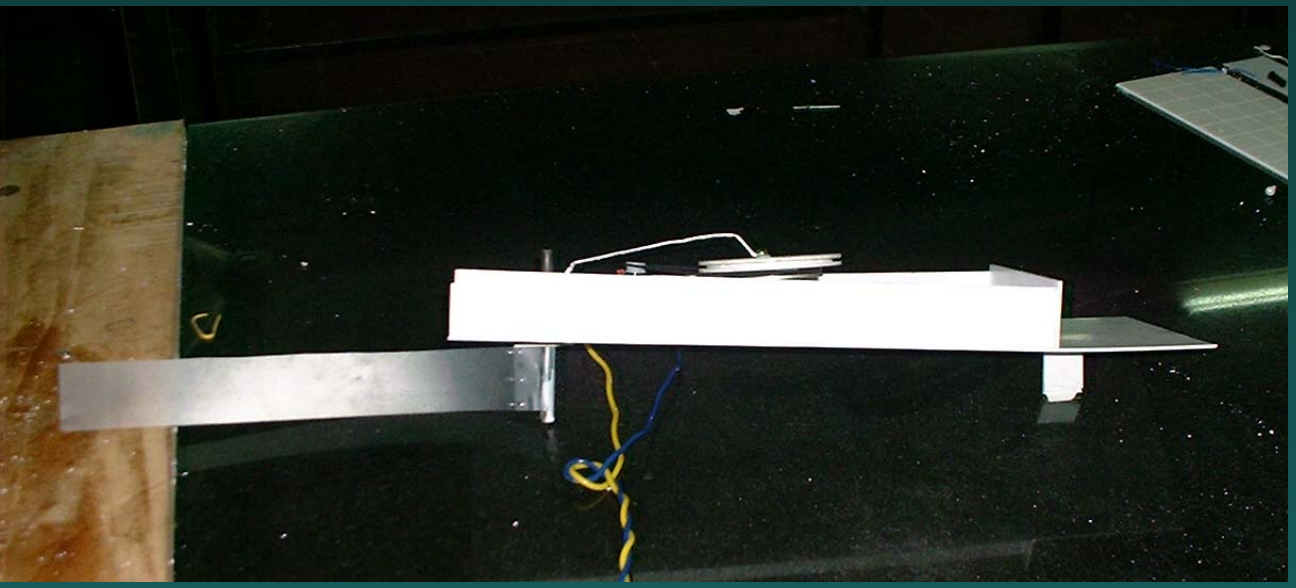
Failed – nodes are restricted, due to which the material of the propeller couldn't simulate the desired bionic action

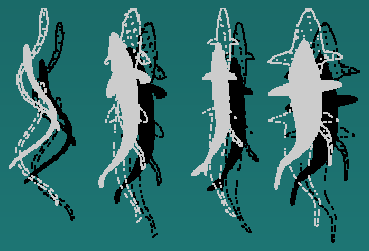
4

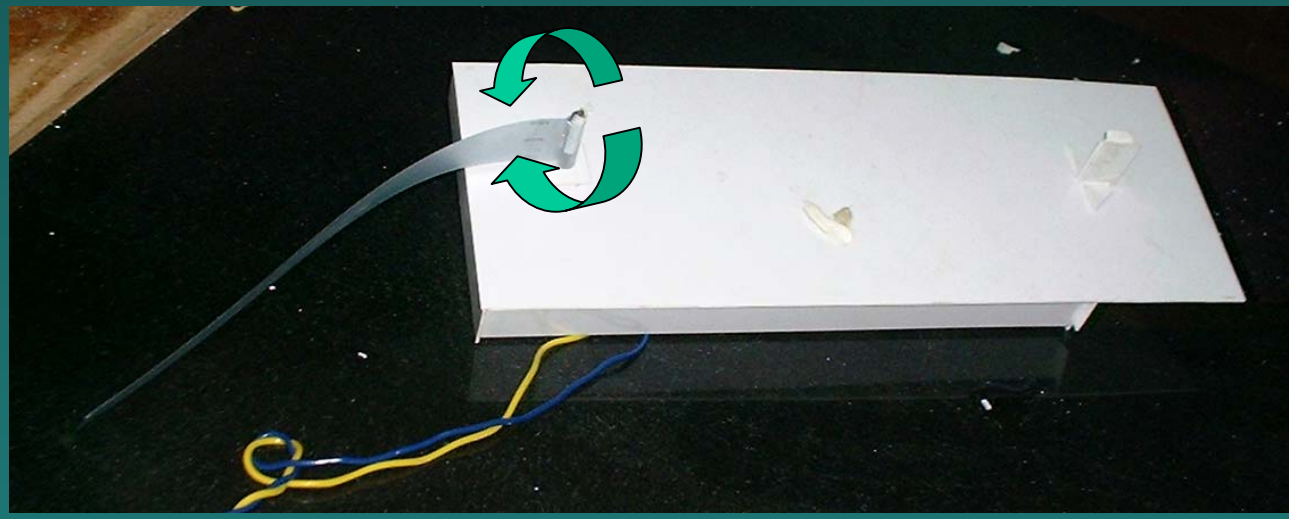




Simplification of the previous concepts







Future scope

Turning action

Backward movement

Perfecting the sinusoidal wave