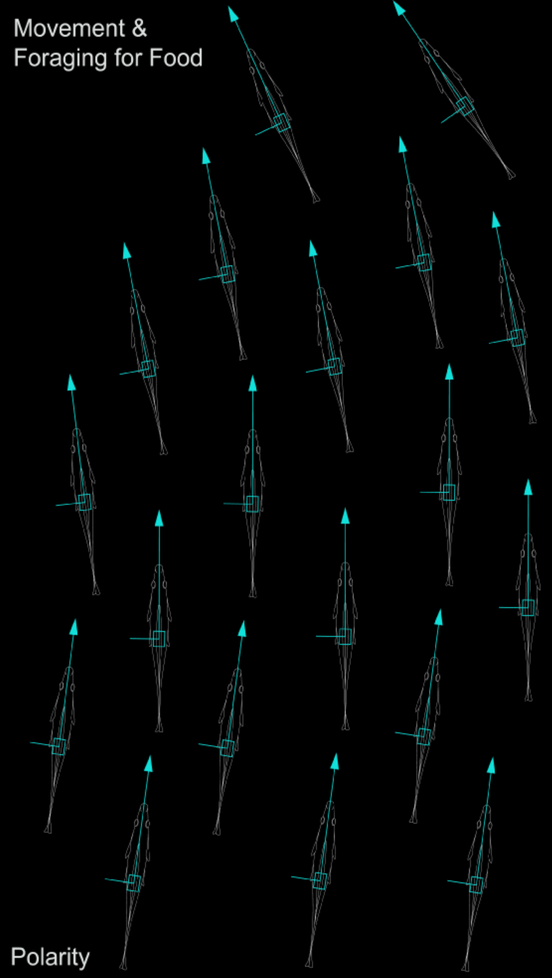
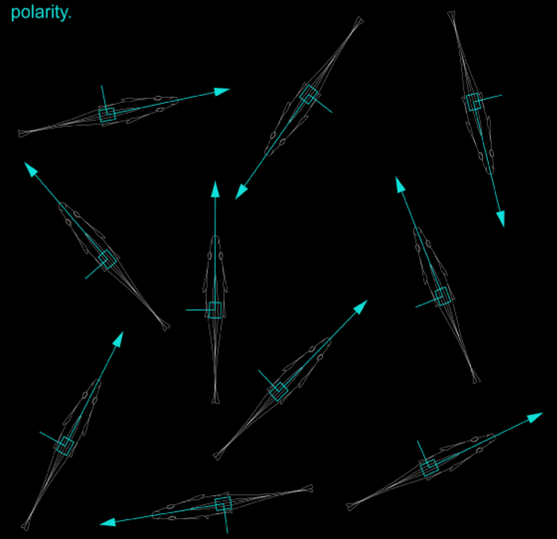
Movement & Foraging for Food



Polarity

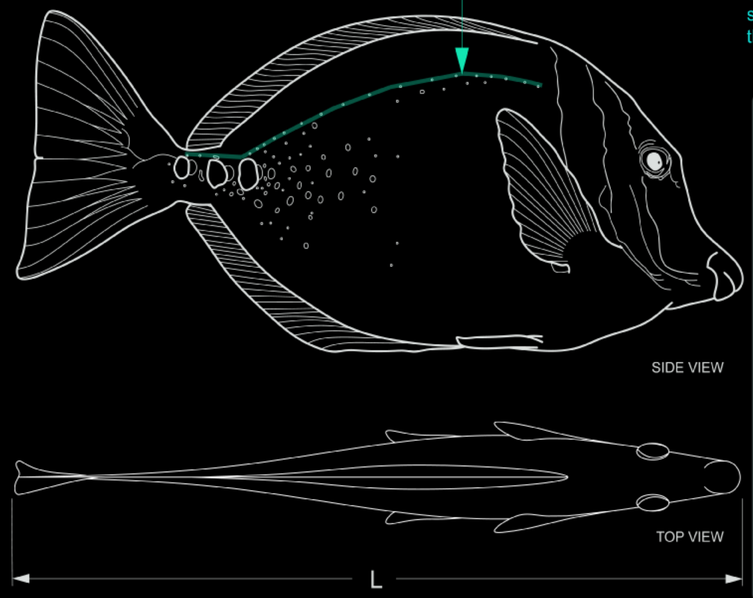
Polarity varies depending on species and activity. The group polarity describes the extent to which the fish are all pointing in the same direction. In order to determine this parameter, the average orientation of all animals in the group is determined. For each animal, the angular difference between its orientation and the group orientation is then found. The group polarity is the average of these differences. School activities such as migratory movement or evading a preditor require a small range of polarity. While some techniques for foraging for food allow for a loose association creating a large range in degree of polarity.



Many type of freshwater and salt water fish school and shoal for 50% of their life. A small portion of fish school or shoal their entire life.

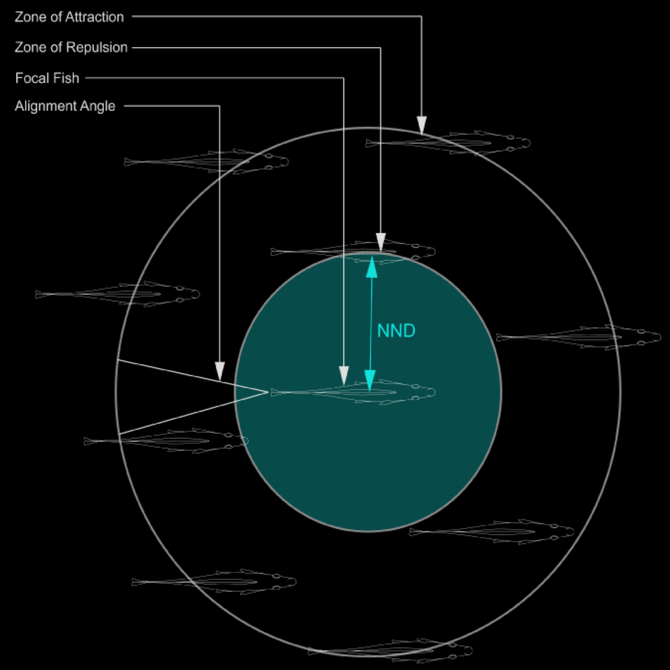
The lateral line is a tactile sensory organ in fish, used to detect movement and vibration in the surrounding water through changes in water pressure. Sometimes parts of the lateral organ are modified into electroreceptors, which are organs used to detect electrical impulses.

YELLOWTAIL SURGEON FISH



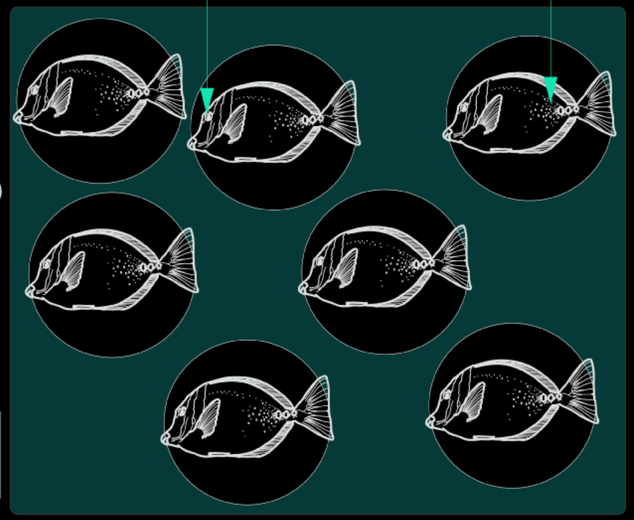
Spacing Areas

Nearest neighbor distance (NND) - describes the distance between the centroid of one fish (the focal fish) and the centroid of the fish nearest to the focal fish. The NND is also related to the density; for schooling fish the NND is usually between one-half and one body length.



One puzzling aspect of shoal selection is how a fish can choose to join a shoal of animals similar to themselves, given that it cannot know its own appearance. Experiments with zebrafish have shown that shoal preference is a learned ability, not innate. A zebrafish tends to associate with shoals that resemble shoals in which it was reared, that is, a form of imprinting.

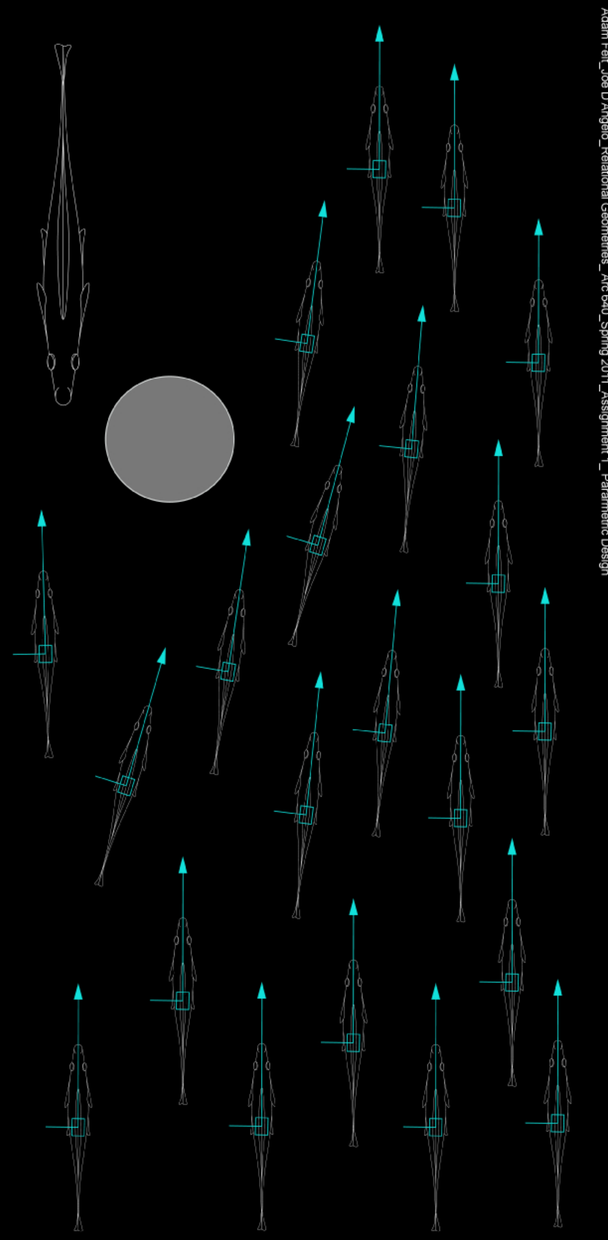
Most schools lose their schooling abilities after dark, and just shoal. This indicates that vision is important to schooling. The importance of vision is also indicated by the behaviour of fish who have been temporarily blinded. Schooling species have eyes on the sides of their heads, which means they can easily see their neighbours.



Less dense aggregations have a packing fraction that is Approaching 0 where the more dense ones have a packing fraction that is approaching 1.

Packing Fraction

Packing Fraction is a parameter borrowed from physics to define the organization (or state i.e. solid, liquid, or gas) of 3D fish groups. It is an alternative measure to density. In this parameter, the aggregation is idealized as an ensemble of solid spheres, with each fish at the center of a sphere. The packing fraction is defined as the ratio of the total volume occupied by all individual spheres divided by the global volume of the aggregation. Values range from zero to one, where a small packing fraction represents a dilute system like a gas.



Decision Making

Fish used consensus decision-making when deciding which fish model to follow. The fish did this by a simple quorum rule such that individuals watched the decisions of others before making their own decisions. This technique generally resulted in the 'correct' decision but occasionally cascaded into the 'incorrect' decision. In addition, as the group size increased, the fish made more accurate decisions in following the more attractive fish model. Consensus decision-making, a form of collective intelligence, thus effectively uses information from multiple sources to generally reach the correct conclusion.

> # of  =Better Decisions

The size of the entire shoal effects the decision making capabilities for the entire school.

Adam Felt_Joe D'Angelo_Relational Geometries_ Arc 640_Spring 2011_Assignment 1_ Parametric Design