Praying Mantis Behavior Model Questions

- How far away are various objects detected? (prey, predators, mates, etc.)
There is not a "limit detection distance". Regarding optical detection, limits should be related to light intensity.

At least in the experimental settings we used, there is no conduct related to the detection of objects out of the reach of a jump (they can jump up to six or eight times their size). Consequently, there is no way of deciding between these two interpretations:

1. They can estimate larger distances, but decide not to jump.
2. They can't estimate distances larger than their "jumping reach".

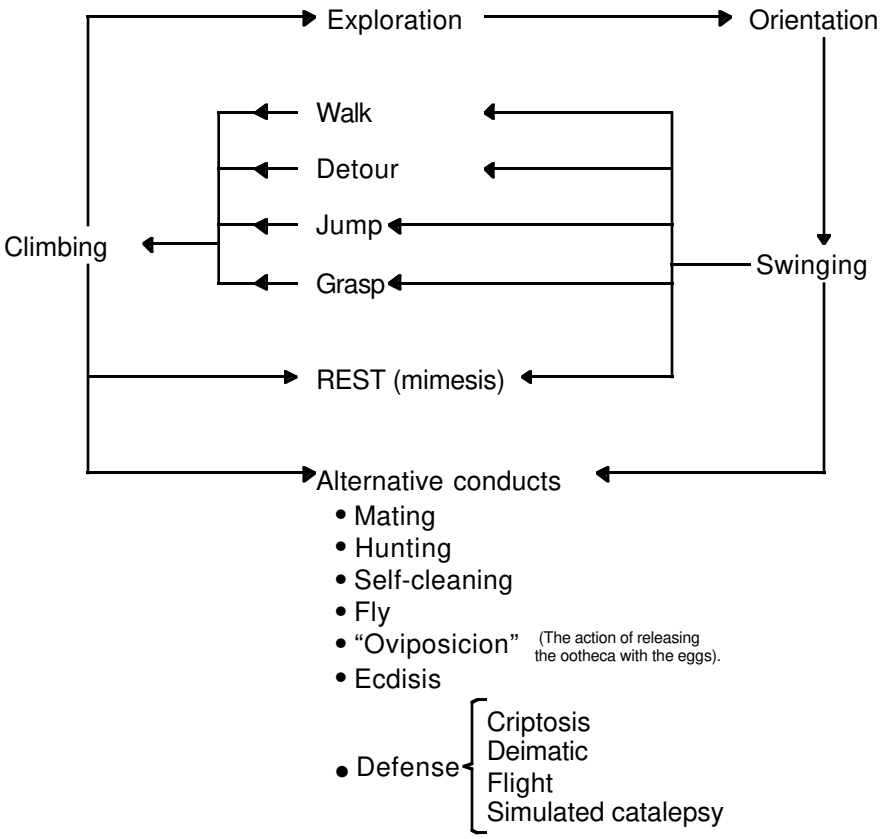
A research group from Venezuela (Maldonado and colegues), ran a series of experiments under the prey-catching behavior, and found similar results: there is a distance at which these animals display the prey-catching behavior and, after a limit not well defined, they do'nt display it. But, again, it cannot be determined whether the mantids are able to calculate the distance, and decide not to capture the prey, or not.

- What is the visual field of view?
Depending on the species (we have worked with: *Stagmomantis Limbata Hann and Yersinios sp*), the size of the mantises' eyes and their position in the dorsal part of the animal's head may vary; thus, based on thier position and curvature, these animal's visual field can be as wide as 240 degrees in the horizontal view, and 360 degrees in the vertical one. In this way, the visual fields of both eyes overlap extensively to give these animals binocular vision in a great part of the visual field, up, down and in front of the animal's head (Horridge, 1977; Goldsmith, 1974 and Atkins, 1980).

- Is there any bias in the search pattern or is it random?
When these animals are placed in an open field (in our experiments they are placed on top of a platform with a hight that is sufficient for gettings these animals to show what we have defined as the *Chantlitaxia* behavior (from the nahuatl voice **chantl**=house, and the geek **taxia**=search), see figure below (Lara et. al., 1984).

In the Chantlitaxia behavior, first, Mantids **explore** the surrounding environment looking for places higher than the platform where they are placed, which can be reached, and where the probability of being seen by potencial preys and predators be low. Exploring the surroundings consists of a series of **random actions** (mainly orienting behaviors) towards different directions and parts of the platform, which stop once a higher place has been located (a pole in our experimental set up).

After orienting towards the pole, the animals dispaly a series of actions (i.e., swinging, walking, jumping, grasping) which are **not ramdomly executed**, rather they are visually guided behaviors (e.g., if the pole is very closed to the platform the mantis just grasps the pole and then climbs it to the top, where a new exploration takes place). In the same way there are other alternative behaviors that can be displayed based on visual stimuli that may appear in the animals visual field (e.g., prey-catching, mating, etc.).



Etogram of mantid *Chantlitaxia* (taken from Franco and Cervantes-Pérez, 1990).

That is, in this case, the activation of one of these behaviors depends on environmental situations. If there are no moving objects around, the mantis explores its surroundings; if it finds an object higher than the substrate where the animal is placed, it orients towards the object and *swings* (Franco & Cervantes-Pérez, 1990) presumably to estimate the distance at which this object is located. Afterwards, the mantis reaches the object and climbs up to the highest part of it .

Additionally, these animals may find several targets, in a given situation (e.g., two higher places, poles in our experiments). In this case, they carry out some processing of visual signals to select the proper behavior (e.g., if the platform is very close to the ground they walk towards the closest pole, or if it is high then they display a ballistic jump). Also, in our experimental set up, when a mantis is placed on a platform in front of two poles, that can be reached by the animal, it prefers to jump towards the pole that is closer to the platform.

How often do they look for food?
At what times of the day?
Mantises are "animals"; they do their "hunting" mainly during the first hours of the day, but also gather and feed around artificial light sources.

Is the appetite motivated temporally?
What does the motivation function look like for appetite, i.e., does the appetite slowly increase, gradually increasing the desire for food, is it thresholded, or what?

We have not much information about this kind of periodicity, or about the "motivation function". They appear to explore the neighborhood in order to find any kind of "goal" (meaning higher places, mates or food) and react accordingly.

Do they remember hiding places?
No, they don't have a definite hiding place... they prefer a *type* of place for hidding, but don't care about where exactly it is. For example, when looking for a refugee, they can hide in the trees, at certain high; they look for *a* tree, but not for "*their*" tree.

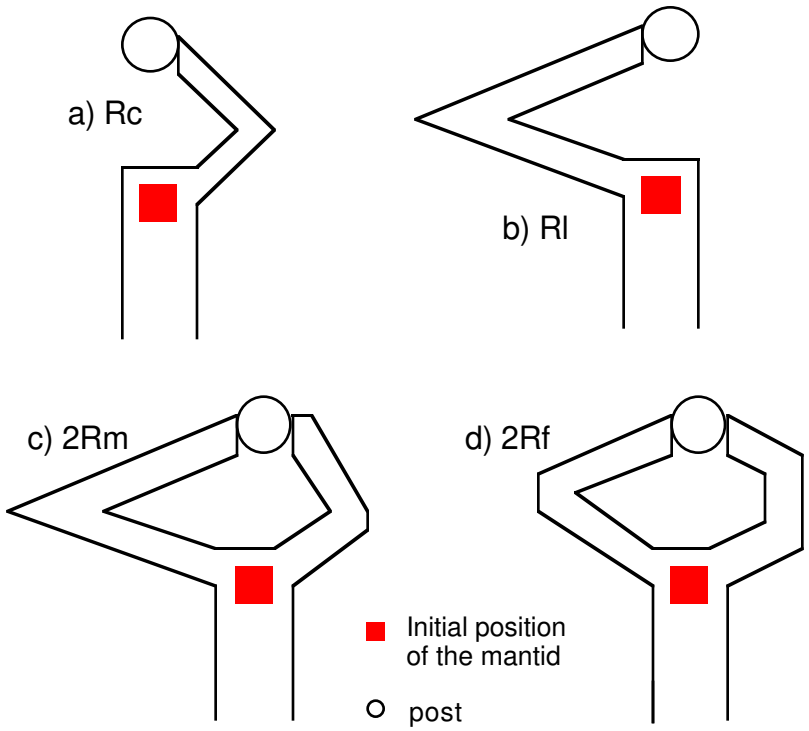
All mantids are cannibals, therefore young animals stay in the lower bushes, and move frequently; whereas adults mantids tend to remain almost immobile in the top of the trees until a predator or a prey is detected. That is, they tend to distribute in the field according to their age.

Do they return to a hiding place?

Look the previous answer.

Characterization of some aspects of *Chantlitaxia*
We conducted other experiments to characterize what a mantid does when confronted with different scenarios. One of them is as follows:

The mantis is placed in a situation where it has the possibility of displaying one of different behaviors; a pole can be reached by displaying, one of three different actions:



Experimental scenarios used.
a) Short route and ditch
b) Long route and ditch
c) Two routes of different length
d) Two routes of the same length, but different form

The figure shows the configuration of the test scenarios for the experiments we carried out. In the first one, there is a platform (where the mantis is placed at the beginning of the test) separated by a ditch from the "goal" (a pole), but having a direct route to the pole. Here the mantis may reach the pole be walking through the route or jumping towards the pole

Short route
The route may be short, the length of the path is about three times the average size of the animals used. The route (right, left) was selected randomly in each test. There are just two possible ways of reaching the post: short round-walk and jump. It was used with eight mantids in each of the first six instars (stages), six from the 7th and five adults; 10 trials were done with each one.

Long route
Or the route may be long, the lenght of the route was about six times that of the mantis.

Two routes with different length
In these test, the platform had two different routes to the pole; the left or right position of the short route was selected at random. In these scenario, there are, at least, three possible actions to reach the pole: a short route, a long route and a ballistic jump.

Instar	Rc	Rl	Dt	Df
1	2.46	4.92	1.64	3.28
2	3.39	6.78	2.26	4.52
3	4.50	9.00	3.00	6.00
4	7.20	14.40	4.80	9.60
5	8.40	16.80	5.60	11.20
6	11.10	22.20	7.40	14.80
7	13.20	26.40	8.80	17.60
8	18.00	36.00	12.00	24.00

Dimensions (in centimeters) of routes and ditches used in the experiment. Rc= Short route; Rl=long route; t=Ditch; Df=length of routes with equal size and different form.

Behavioral results

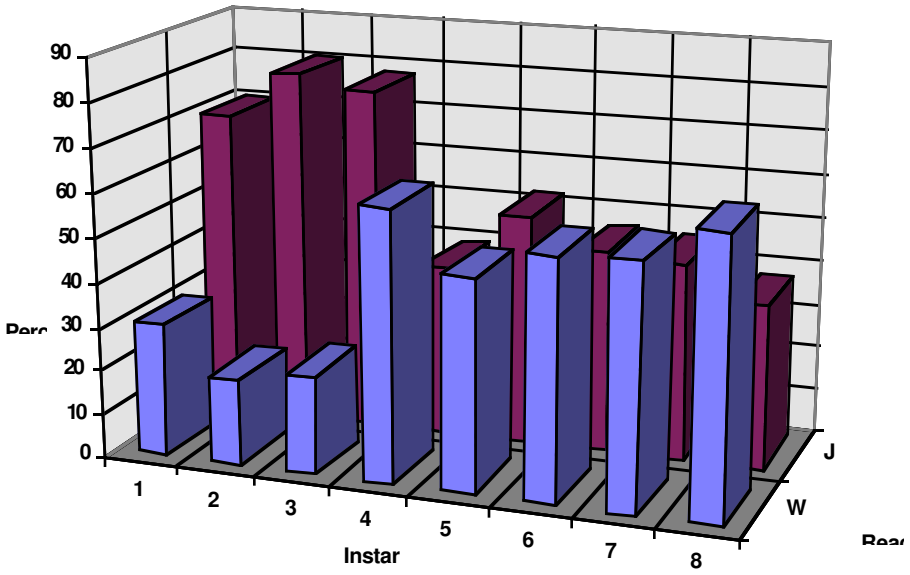
Short route and ditch
When placed in the Rc scenario, all mantids, no matter in wich instar they were, always selected the short route instead of the jump option.

Long route and ditch
In this case, they must decide between *jumping* (J) and *walking* (W) through a path six times their size. The table shows the percentage of each reaction.

Instar	#	W	J
1	11	30.12	69.87
2	10	19.54	80.45
3	10	22.22	77.77
4	10	61.25	38.75
5	4	47.80	52.20

6	4	54.20	45.80
7	3	55.00	45.00
8	5	62.50	37.50

#: denotes the number of mantids used for the test.



Two routes of different length and ditch
In this case, there were three expected reactions:

Walk through the short route, (Rc)
Walk thruogh the long rote, (Rl)
Jump (J).

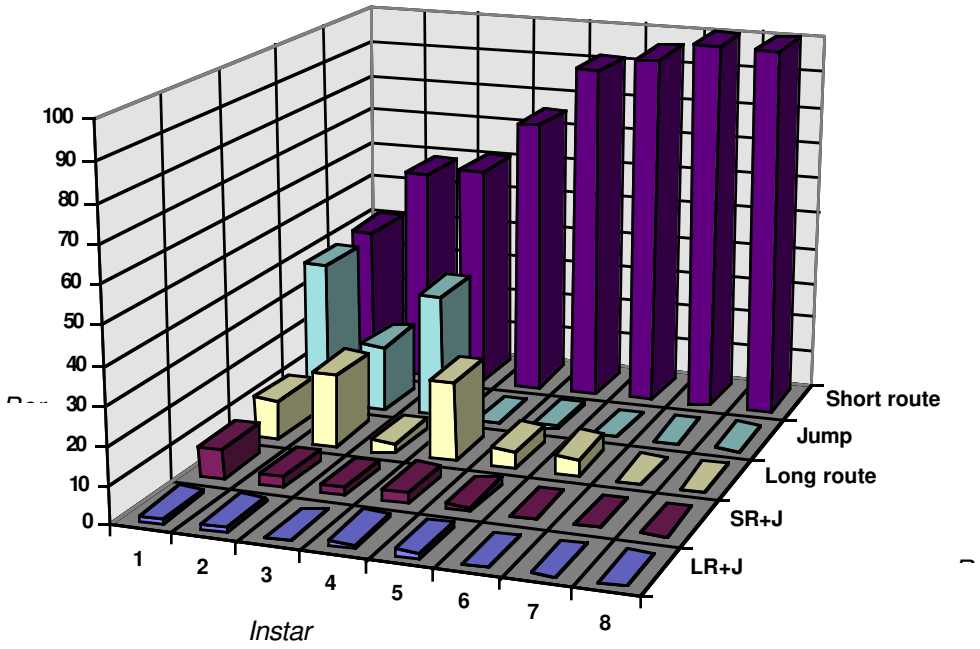
But the mantids showed two additional ones:

Walk through the short route and jump (Rc+)
Walk through the long route and jump (Rl+)

Percentages were as follows:

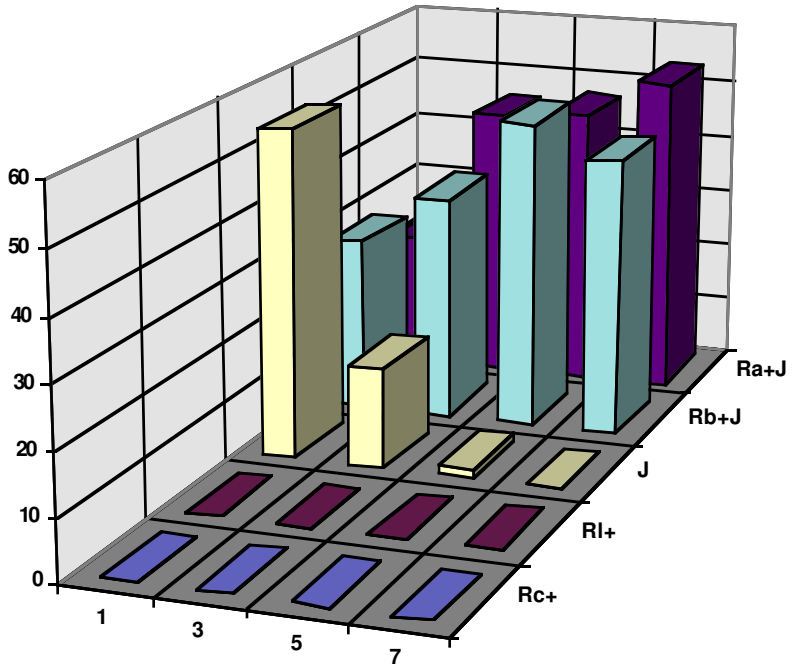
Instar	#	Rc	Rl	J	Rc+	Rl+
1	8	40.54	10.81	39.18	8.10	1.35
2	9	58.33	19.44	18.05	2.77	1.38
3	11	61.05	3.15	33.68	2.10	0.00
4	9	75.00	21.05	0.00	2.63	1.31
5	10	91.56	4.81	1.20	1.20	1.20
6	6	95.50	4.60	0.00	0.00	0.00
7	6	100.00	0.00	0.00	0.00	0.00
8	5	100.00	0.00	0.00	0.00	0.00

#: denotes the number of mantids used for the test.



The percentages of the last experiment were as follows:

Instar	#	Ra	Rb	J	Rc+	Rl+
1	8	22.50	29.03	54.51	0.00	0.00
3	11	45.87	37.61	16.51	0.00	0.00
5	7	46.96	51.51	1.53	0.00	0.00
7	4	53.57	46.43	0.00	0.00	0.00



What are the characteristics of a good hidding place?

To be as high as possible (mantids always try to reach higher places), and not to albergate predators (bigger mantids beeing one of them).

How far will they wander (their range)?
(in search for food, in search for mate)

There in not much information about it. As far as I know, there are no experiments on the field (animals natural environment). Although, we know that adult animals are very static, thus, they don't wander too far.

Do they follow any pattern?

No.

How often do they mate?

- **Is it motivated by time season?**
- **What is a suitable motivation function for their sex drive?**
  If so, what are the motivators (time, etc)?

About mating I don't have enough information but I will look in the literature. We know they mate only when they reach the last instar (when they become adult). I do'nt think the behavior is motivated by special situations, but an interesting data is that females are able to produce eggs without mating, that is if they do'nt find a male, they are still able to have descendents (I am not sure if theis word is correct, but I mean baby mantises). Thus, I think it is fair to assume that this behavior is motivated by time: the female age.