***Euglandina rosea* detection by dogs, February-March 2010**

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April 18, 2010

Summary:
Between 20 February and 20 March 2010, Working Dogs for Conservation (WDC) continued training and fielding of two conservation detection dogs on the scent of *Euglandina rosea* in the Wai'anae Range on Oahu, Hawaii.

The purpose of this report is to summarize the training and fielding activities of 2009/2010, and provide recommendations for future use of dogs to detect *Euglandina rosea*. Accompanying this report is a spreadsheet of the training and trial results for 2010.

Summarized training activities:

Dog	2009 # rewards for Euglandina	# rewards for Euglandina in Montana between 2009 and 2010	2010 # rewards for Euglandina In Hawaii	TOTAL # rewards for Euglandina
Tia	237	35	115	387
Tsavo	201	n/a	n/a	201
Wicket	255	74	98	427

In 2009, we performed a variety of training scenarios with three dogs including: known line-ups; blind area (placed snails); blind area (wild and untouched, but previously located); piles of multiple snails to increase amount of odor; known area; blind area with wild snails; 'point of last seen' searches where the snail was once seen but has gone missing; placed snails contained in place overnight; and placed *Euglandina* in proximity to other placed non-target snails (African, and small sea snails). Finally, we performed searches in areas not yet searched visually by people in order to mimic more realistic search scenarios.

Dogs completed the 2009 season detecting snails in a training scenario and performing unprompted alerts upon locating a snail in order to inform the handler of the find. We conducted a few searches for wild snails and did find some wild snails at the rate equal to human visual searchers. However, we hoped that through repeated exposure to *Euglandina* that the dogs would become more sensitive to the scent and be able to either increase detection distances or reduce the number of times they needed to have their noses close to the snail before detecting them (termed "number of approaches"). To this end, we then continued training back in Montana and returned to Oahu in 2010.

For this 2010 season we did only a small number of known line-ups and then moved to known area and blind area searches with placed snails with two dogs. After the first few days, we started working only with wild, unhandled snails as well as doing more searches where the area had not already been scanned by people searchers. The additional objectives for this year were to increase the number of repetitions and reward opportunities, work the dogs in variable vegetation types and forest floor debris, maximize the length of time dogs could work, support nose-to-ground search behavior, and field dogs in a manner which might represent ways in which they would be fielded should dogs be used in actual searches.

We did not see a notable increase in detection distance. Because we worked with so many wild snails whose locations were unknown to the handler, we were often not able to track the number of approaches required. However, we noted improvement in search behavior, notably the ability of the dogs to keep their noses on the ground thus improving search efficiency.

Field testing 2010:
We completed the 2010 season by visiting an area (Land of 10,000 Snails) where both *Achatinella* and *Euglandina* are present and which will be the site of a new exclosure which will house *Achatinella*. Vince Costello has data on how many *Euglandina* of small (under 25mm) and large (25mm and over) have been located over how many person-hours of searching during 10 visits over the last 15 months. We searched with the dogs and then compared our results to these data from human visual searchers. We also went to an area near an existing exclosure in Kahanaha'iki where people regularly search small areas for *Euglandina* at the base of trees known to house *Achatinella*. In the Kahanaha'iki area, dog results matched that of people: finding no snails where people typically don't find snails, and finding one snail in areas where people usually find one snail.

Results from the Land of 10K Snails are as follows:

	people	Aimee/Wicket	Alice/Tia	Combined Dog
# Eugl found <25mm	119	18	6	24
# Eugl found >25mm	206	4	3	7
Total Eugl found	325	22	9	31
Hours searched	140	6.75	5.73	12.48
Avg Eugl/hour*	2.43	3.26	1.57	2.48
% small Eugl of total find**	39.5%	81.8%	66.7%	77.4%
% found "loose" as opposed to stuck on leaf/rock/root	Not recorded	72.8%	88.9%	77%
% dog found before people saw it	n/a	59%	44%	55%

*range of Eugl/hour for people: 1.4-3.78
** range of small Eugl relative to all found: 16-58.8%

We recognize that this is not a one-to-one comparison, because the searching was not conducted simultaneously and there is a much larger sample size for people than for dogs. However, when people and dogs try to search immediately following each other, the one who follows has a search that has been impacted by the one who searched before them- either the debris has been moved and the snail is more obvious for the second team, or the snail has been bumped and lost in a crack and less obvious for the second team, or has moved out of the area entirely. So we use this not as an absolute comparison, but as suggestive data.

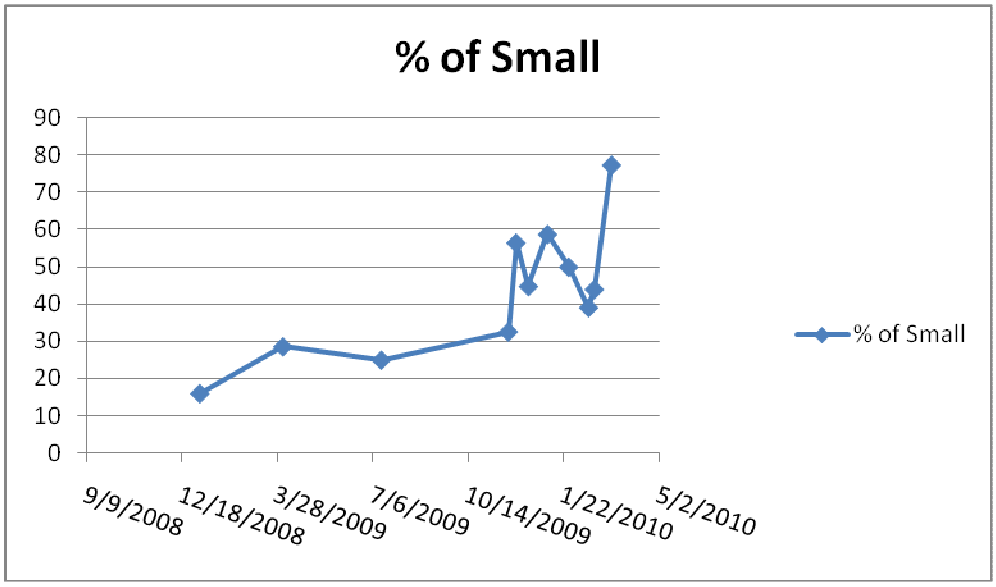
Also, our sample size in terms of number of hours searched is too small here to definitively indicate that there's a difference between the two dog teams, especially given that the teams searched different areas which had dramatically different vegetation and ground debris (e.g. recent cut of Christmas berry trees covered in logs and stick litter vs. pisonia patch, and pisonia patch vs. ieie patch). However, we wanted to present results from both teams in order to show the range of the results gathered.

"Hours searched" for dog teams include the time that the dogs are taking a break, since this is the practical deployed time. However, if we use only the actual time the dogs were searching, then dog team finds per hour would increase to 4.56 for team Aimee/Wicket or 1.96 for team Alice/Tia, or 3.3 snails per hour overall, which would exceed the per hour average for people searching visually.

Note that a "team" consists of one dog and one handler and each team is counted as one collective unit in time. Though the handler sometimes sees a snail before the dog smells it, the primary activity of the handler is to guide the dog, not comprehensively visually search for snails, and so is not considered an independent search unit.

Even though a team is one collective unit, we still track how often the dog finds the snail before the handler in order to track how each member of the team is contributing to the overall search. Over half of the time (55%), dogs detected snails before the handler saw it. This is in contrast to how it occurred in training, when only 22% of the time dogs found it before the handler saw the snail. This is likely due to a couple of reasons: 1) in training, snails used are often large and therefore more easily seen, and 2) even while doing "blind" searches in training where the handler doesn't know where the snail is located, there is usually the expectation that a snail is there somewhere and it's likely that the handler is visually searching harder during training than during hours of actual deployment. This is a good example of how training data is not necessarily representative of actual search data.

The most notable result is likely the percentage of snails less than 25mm found by dogs relative to people (77.4% and 39.5%, respectively). It is possible, even likely, that *Euglandina* demographics are changing in this area due to regular and frequent visits by searchers. It's logical that the larger snails, which are more visually obvious than small snails, are becoming less abundant while more small snails persist. By graphing the percentage of small snails collected, we see that over the last few months the number of small snails found is trending upwards. However, even in this context, the final diamond represents the dog team finds and clearly stands out as a high number of small snails found.



It's worth noting that ¾ of the snails located by dog teams were "loose", as opposed to fixed on leaves or other objects. This could potentially be improved upon by additional training, or at the least, could be

used to inform handlers of where they need to be looking as they supplement the dog's olfactory search for snails.

Overall, in all field tests we found that dog teams either matched or exceeded measures of human visual searchers.

Challenges, considerations, and lessons learned:

- Non-targets and empty shells: Aside from one training session in 2009 where dogs were exposed to sea snails and African snails in a lineup with *Euglandina*, we did not focus on training 'off' of non-target species. It appears that training with live *Euglandina* is sufficient for the dogs to learn to detect only live *Euglandina* and ignore non-targets. Dogs were observed sniffing empty *Euglandina* shells, *Achatinella* shells, and live slugs. Both dogs would alert to a freshly crushed *Euglandina* (e.g. stepped on by handler), but otherwise stayed on-target. Only one dog ever alerted to non-targets, but less than 1% of her alerts were on non-targets.
- Our assumption is that the *Euglandina* do not produce very much scent relative to the ambient environment as opposed to there being any reason inherent to the odor that makes it necessary for the dogs to be so close to the snails in order to detect them. We corroborated this assumption by showing that when piled together, thereby creating more odor, the dogs were able to find the snails from several meters away.
- Slope, ground cover, and debris all impact ease of detection. Steep slopes are challenging because the dog's feet are likely to be slipping and pushing the ground debris, and any hidden snail, down the slope. Ground cover can be varying depths and unless the handler helps move debris for the dog, snails deeper than the first inch or two will likely go undetected. Also, some leaf duff is strongly aromatic or actively decomposing and gives off strong ambient odor which masks the snail odor. Debris comprised of sticks is too heavy for the dog to effectively push aside for independent searching. Kukui nuts are likewise heavy for the dog to push out of the way, and also appear to have a tactile feel upon the dog's nose similar to that of *Euglandina*. Throughout the course of training all three dogs would sometimes spend more time in kukui debris as they needed to roll the nuts around against their noses and in early training sometimes alerted to kukui nuts. Rocky washes can be challenging because often dogs will knock a snail off of a rock with her body or tail, which then falls deep into a crevice between rocks before the dog gets a chance to smell it.
- Snails loose on the ground appeared to be more detectable than those affixed to leaves or other surfaces. It's likely that there's less odor escaping from a snail that is affixed to a surface than a snail whose fleshy parts are exposed at the shell opening as on a loose snail. Also, as leaf litter is very easy for a dog to push around with her nose, as the dog tries to pinpoint the location of a snail on a leaf she often ends up nudging the leaf away and thereby losing the scent.
- Loose snails up against a root, log, rock, or other feature seem slightly more detectable than loose snails in the middle of an opening. They are less likely to be inadvertently nudged out of the way by the dog's nose, and also they have the opportunity to "catch" scent against the feature, creating a small "pool" of accumulated scent which is helpful for detection.
- Among the dozens of targets (live animal, scat, and plants) that WDC dogs have been trained to, *Euglandina* requires the most investigation by the dogs in order for them to be fully convinced that it is the correct target before alerting. This investigation comes in the form of having to directly contact the snail and either lick it, press it with their noses, or scrape their teeth against it. This need for tactile corroboration is unprecedented in our experience. Since this obviously

presents a danger to the snail, it does suggest that using dogs to locate invasive, unwanted snails may be appropriate, but likely would not be acceptable for native snail detection.

- Team variation- just as not all humans are equally effective at visually locating *Euglandina*, neither should all dogs be expected to perform equally. Since many of the targets are found by the handlers prior to the dog finding them, individual handler variation in ability to see *Euglandina* also will come into play as well as handler aptitude to maintain detailed searching and directing the dog effectively over time. So, while we can describe which snails are seen by the handler first versus those that are found by the dog first, the overall performance capability is a product of teamwork and not the dog or handler individually.
- Handlers are primarily focusing on the dog, and while they accomplish some degree of visual searching, it is not to the same extent that a person searching alone would be looking. This is because the handler has to conduct him/herself in a way to maximize the dog's searching (e.g. a handler may point out or move a bit of debris to gain the dog access to an area, but won't likely be able to thoroughly move all of the debris without excessively distracting the dog).
- While dogs can often search for many targets simultaneously, it's unlikely that a dog searching for *Euglandina* could successfully search for another target at the same time, unless the other target was another slug or snail likely to require the same degree of detailed searching and likely to inhabit the same area. This is due to the level of detail required; therefore the dogs just won't cover enough area to look for other targets.
- We conducted both "hasty" and "detailed" searches. During hasty searches we pointed out very few targets to the dogs and moved relatively quickly through the area. During detailed searches we watched the dog's nose to ensure she sniffed each square foot of the area. Hasty searches produced very few finds and so detailed searches appear to be the best use of time. However, at the Land of 10K Snails, the areas were too large to have the dog cover every square foot in our given time. In that case, a detailed search consisted of the handler choosing to walk through some areas in favor of having the dog more heavily search other areas. This is consistent with how human visual searchers allocate their search time as well, but may not ultimately be the best deployment method for dogs. We recommend that future teams, if deployed, continue to experiment with search strategy.
- While in the Land of 10K snails, it appeared as though small snails maintained a "clumped" distribution: where we found one there were others. One effective search tactic then may be for dog teams to locate a new "clump" area, and then visual searchers come behind and comprehensively comb that area for additional snails.
- We primarily worked in morning to early afternoon. *Euglandina* detection may be susceptible to microclimate conditions given the level of detail required to locate them, and daily variation in temperature and humidity create different predictable air flow patterns. Therefore, it would be worth trying night searches.

Recommendations:

We feel these results demonstrate that dogs can be trained to detect wild *Euglandina rosea* in natural environments on Oahu. They clearly demonstrated the ability to recognize *Euglandina rosea* scent, work towards it from limited distances to pinpoint the source of the odor, ignore other odors present in the area, and communicate the location of the *Euglandina* to their handlers.

In order to detect the snails, the dogs needed to keep their noses pressed to the ground with very rapid successive sniff/exhalation cycles. Dogs were most successful at detecting snails when they could sniff them directly and might find them at a distance of up to 12 inches away. We do not believe that additional repetition or experience would increase the detection distance significantly for any dog, because the dog

must consistently contend with the rather faint odor of the snail in the context of a rich background odor (pungent soil and vegetation and decaying ground debris). Additional experience for these, or any, dogs would improve is the length of time that the dog is able to search without breaks, and improved search behavior (keeping nose-to-ground throughout the search, self-targeting crevices). This results in a very detailed level of searching wherein the handler is very involved pointing out crevices and features for the dog to check as well as moving rocks and ground-covering debris out of the way so that the dog can access the area with its nose. Because of this, it takes a relatively long time for dogs to search fairly small areas. Additionally, because of this high detail and slow speed of the search, often the handler sees the snail before the dog smells it.

Therefore, we think there are some applications for which dogs may be a helpful additional tool for OANRP but because field tests did not show that dogs vastly exceeded human visual searchers we do not see the day-to-day utility of dogs being sufficient to recommend OANRP contract with WDC to establish OANRP's own *Euglandina* detection dog program. Based on our searches, we think dogs are likely to be the most valuable searching areas which are destined to become *Achatinella* exclosures and where *Euglandina* need to be systematically removed from the area, or other areas of high *Euglandina* density for which the larger snails in the population have been located and smaller *Euglandina* remain, as this is the search scenario in which the dogs appeared to have the potential to surpass human searchers. Dogs appeared to have results on par with human searchers in conducting small area searches underneath trees known to contain *Achatinella*. Though not measured directly, it does not appear that dogs would be very helpful in locating new areas of *Euglandina* infestation. This is because in order to locate new areas, a lot of ground must be covered quite quickly and the dogs do not locate *Euglandina* while moving quickly through an area or when their heads are above ground level, which is the head position of a dog walking through the forest. Also, because of the short detection distances, dogs will not be an effective tool for finding *Euglandina* in trees above the height where the dog can directly sniff the trunk or branch (and even this level of tree detection will require the dog to have repeated training with snails on trees).

Should OANRP desire to continue to employ dogs in these suggested applications, we recommend continued contracting with WDC and trying out an on-island source for detection dogs. Though we haven't personally seen the dogs of Kris Lesperance, after spending hours with her, we find her to be credible and experienced with various detection targets and is the local trainer we suggest for working with OANRP. Each option confers advantages: by continued contracting with WDC we can send our highest-performing team which would be able to engage in *Euglandina* detection with minimal (1-2 day) reminder training prior to deployment. We have a baseline determined for this team and therefore have realistic performance expectations, as well as an intimate understanding of the time and training already invested into *Euglandina* detection. By working with a local source, transport and lodging costs are greatly diminished and the dog(s) will be fully acclimated to Oahu as well as more readily available for frequent short-term deployments if needed. Perhaps the option to offer the greatest assurance to OANRP to meet short-term needs and ensuring future team availability—if future teams are required after the creation of the next planned exclosure area—would be to use both WDC and the local source for the next exclosure area, where WDC would be able to bring the calibrated team and also be available to personally share experiences with the local source.

We at WDC are thankful for the opportunity to puzzle through *Euglandina* detection with OANRP, and hope that we can continue to be of assistance as you determine if and how detection dogs have a role in your efforts to protect *Achatinella*.