

Addressing Undesired Sexual Behavior in Kakapo (*Strigops habroptilia*)

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Abstract: The kakapo (*Strigops habroptilia*) has been reduced to 125 individuals. Sirocco, an imprinted male has been appointed ambassador for the conservation project. Because of an illness he was raised by humans and without con-specifics. The viral video from the BBC series *Last Chance to See*, demonstrates Sirocco's sexual behavior towards humans is a problem.

<http://www.youtube.com/watch?v=9T1vfsHYiKY> This paper will explain the behavior modification procedures used by the author to address the undesired behavior exhibited by this individual.

Kakapo Natural History

Although a member of the family Psittacidae, kakapo (*S habroptilia*) are unique in many ways. Kakapo (*S habroptilia*) are solitary, nocturnal and flightless. They are quiet, slow moving and usually asleep in a tree during the day. Their mossy colors make ideal camouflage. It is believed they evolved with no ground predators, only a now extinct bird of prey. Their coloration and tendency to remain motionless during the day supports this theory. When the sun goes down kakapo (*S habroptilia*) demonstrate how well adapted they are for darkness. They can charge through brush with precision. They are keenly sensitive to sound and in many ways transform into an agile creature when night falls. It is clear night-time is when a kakapo (*S habroptilia*) is at its best.

Kakapo (*S habroptilia*) also emit a musky odor that is often described as similar to an old violin case. Although social odors are practically unstudied in birds, characteristic scents exhibit intriguing links with the breeding behaviors of Crested Auklets (*Aethia cristatella*) Bulwer's Petrels (*Bulweria bulwerii*) and Mallards (*Anas platyrhynchos*). Given the solitary nature of the kakapo (*S habroptilia*), the extreme aggression of males during breeding, and the bird's unusual social system and nocturnal habit feather scent could signal the presence of other individuals, competitors or possibly mates.¹

The kakapo (*S habroptilia*) has a larger olfactory bulb ratio than most non-passerine birds, including those of other parrots. It is similar in size to species that are well known for their sense of smell such as Brown Kiwi (*Apteryx australis*) and Turkey Vulture (*Cathartes aura*) Although it would appear that most birds have at least some propensity for employing odor cues (the ability to discriminate between odors while foraging has been reported for only one other parrot species.)²

Kakapo (*S habroptilia*) are also the heaviest parrot. Females typically weigh anywhere from 1100 grams to 2000 grams. Males can weigh as low as 1600 grams and bulk up to 4000 grams during breeding season.³ The wings are not used for gliding, and the heavy bird often drops to the ground without grace when climbing down to forage. Kakapo (*S habroptilia*) have the smallest relative wing size of any parrot. Although its wing feathers are distributed similarly to other parrots, the primaries and secondaries are shorter, comparatively rounded, show less asymmetry of vanes, and have fewer interlocking barbules at their tips.⁴

Similar to other parrot species, longer light cycles trigger reproductive hormone amplification. However courtship and mating for kakapo (*S habroptilia*) is distinctly different. Unlike other parrots, male kakapo (*S habroptilia*) utilize a lek system to attract females. Males create a series of tracks that lead to small depressions in the ground called bowls. Although the kakapo (*S habroptilia*) males are near each other, their bowls are often separated by a few hundred meters. Ridge tops and summits often appear to be preferred locations for kakapo (*S habroptilia*) bowls. Aggressive behavior between males on the lek is characteristic of the pre-booming period, and is sustained over many nights. Agonistic activities include vigorous chasing, aggressive screeching and fighting.⁵

During breeding season males will utilize the bowls to call females. The male will sit in the bowl with his weight resting on the ground. His body becomes round like a basketball as he inhales air to fill the air sacs on his chest that have swollen in size in preparation for breeding season. The male kakapo (*S habroptilia*) then produces a low frequency “booming” sound that can travel long distances. Humans in close proximity describe the boom as possible of creating vibrations in one’s chest similar to an amplifier. At times the pitch changes to a “chinging” sound which is believed to help pinpoint the males location to the mate seeking female. 6

Males may boom for eight hours a night for three months. This intense commitment to presenting this behavior, requires the males to bulk up in preparation for many nights of little foraging. This massive weight fluctuation is thought to be the most extreme of any land bird. 7

During breeding season male kakapo (*S habroptilia*) are intensely motivated to copulate. Male kakapo (*S habroptilia*) will charge and mount female kakapo (*S habroptilia*), other species of birds and inanimate objects that appear in close proximity to the bowl. Once contact is made, the male will copulate for up to 90 minutes. Females may visit several males. Incubation and rearing is solely the responsibility of the female.

Reproduction of the kakapo (*S habroptilia*) population surviving today has become linked to the availability of the fruit of the Rimu tree. Years that result in high yields of Rimu fruit help stimulate courtship and sexual behavior. Because this does not occur annually, low fruiting seasons result in less booming and more aggressive behavior between males attending their bowls. Kakapo (*S habroptilia*) are believed to live as long as 100 years. For this reason producing offspring each season may be of less importance from an evolutionary perspective. 8

The kakapo (*S habroptilia*) diet is another anomaly. Kakapo (*S habroptilia*) eat a comparatively high fiber low protein diet. They masticate shoots, stems and leaves of a wide variety of vegetation when not in breeding season. The vegetation is chewed and juices are absorbed. A fibrous, dehydrated “chew” is left as evidence of kakapo (*S habroptilia*) foraging efforts. As in other parrots, kakapo (*S habroptilia*) use their feet to hold food items but rarely use them to lift items to their beaks 9

No specific studies of kakapo (*S habroptilia*) vocalizations have been made. The kakapo (*S habroptilia*) has a varied repertoire of calls, which includes a mechanical sound, and a range of calls associated with courtship activities.10 In keeping with their secretive behavior, kakapo (*S habroptilia*) seldom call, except during the courtship season when males occupy track-and-bowl systems and are highly vocal.

Outside the breeding season birds are relatively silent, except when in relatively close proximity to other kakapo (*S habroptilia*). At such times, brief isolated calls may be heard, such as the characteristic “skraak” call. Aggressive “skraaking” is frequently heard during the breeding season. 11 Skraaking birds stand erect and may emit a single skraak or several in quick succession. Skraak calls vary markedly in intensity, from a few short, soft calls to loud drawn-out, braying. Vigorous skraaking often occurs after a chase or fight between two males, as though the victor was vocally proclaiming or reaffirming ownership of his court. Other calls include pig-like grunts and squeals, duck-like “warks”, and donkey-like braying.12

Summary of the unique natural history of the kakapo (*S habroptilia*)

- Nocturnal
- Flightless
- Solitary

- Long lived
- Heaviest Parrot
- Emit/detect odor
- Lekking species
- Males build tracks and bowls
- Males defend bowls
- Males boom and ching for mates
- Males have strong drive to copulate
- Copulate for long periods of time
- Females incubate and raise offspring alone
- High fiber low protein diet
- Specific food and amount required for raising offspring
- Skraak vocalization used under various circumstances

Kakapo Conservation

Kakapo (*S habroptilia*) were once one of the most abundant and widespread bird species in New Zealand. However the introduction of stoats, ferrets, weasels, rats and domestic cats and having evolved with the absence of predatory mammals has rendered them nearly extinct. Aspects of the kakapo's (*S habroptilia*) biology also make it highly vulnerable to introduced mammalian predators. 13 Adult males are particularly vulnerable to such predation during the breeding season when they cluster at traditional leks and advertise their presence by calling (booming) each night for about three months. Likewise, nesting females, eggs and nestlings are highly vulnerable because of the long (c. four month) nesting cycle and the species' ground nesting habit.

In the 1890's Richard Henry was the caretaker of Resolution Island. He moved hundreds of kakapo (*S habroptilia*) to the island in a pioneering translocation to create safe populations. However stoats reached the island by swimming and his efforts were in vain. 14 In the years that followed the kakapo population disappeared from the North Island. Small populations were discovered in the Fiordlands and on Stewart Island. But these too eventually disappeared or the remaining birds were transferred to predator free islands as part of intensive conservation efforts which began in the early 1980's. At the time there were only 40 known kakapo (*S habroptilia*) in existence. The existing population of kakapo (*S habroptilia*) is highly managed by the Department of Conservation Kakapo Recovery team. All the birds live on a handful of predator free islands. Artificial insemination and strategic placement of birds is utilized to increase genetic diversity. The team's efforts have brought the population to the current status of 127 birds. With a goal of creating a sustainable population there is much more work to be done to prevent the extinction of this most unusual parrot.

The Behavior Problem

Sirocco is a male kakapo (*S habroptilia*) that was hatched in 1997. At three weeks of age he developed a respiratory illness that required treatment and subsequent hand-rearing. Having been raised without conspecifics he is imprinted on humans. Like other male kakapo (*S habroptilia*) he comes into breeding condition when light cycles lengthen and the Rimu crop is plentiful. However Sirocco shows no interest in kakapo (*S habroptilia*). Instead he is focused on humans for copulation. Although a video of Sirocco mating with zoologist Mark Cawardine went viral and brought much needed attention to the plight of the kakapo (*S habroptilia*), Sirocco's behavior is problematic.

Sirocco, like all other kakapo (*S habroptilia*), has been free to roam his island habitats. However he typically chooses to be close to the human accommodations. This has historically meant a Sirocco encounter was quite likely for Kakapo Recovery Program rangers and volunteers. Sirocco also built his

bowl near a commonly used pathway to the outhouse. This has led to evening passersby being ambushed by a sexually motivated kakapo (*S habroptilia*) during certain times of the year.

Kakapo (*S habroptilia*) are impeccable climbers. Being flightless and the heaviest parrot species, their feet and beak need to be quite powerful to climb trees or humans. Sirocco targets the back of people's heads for copulation. He starts his climb usually with the lip of a gumboot and quickly maneuvers to the person's shoulder. Attempts to thwart his actions often lead to aggressive behavior. To address the problem, Sirocco was avoided, aversives were attempted to stop his behavior and finally a wall was built around the pathway to block his access to people. The wall did prevent access on the pathway, but did not remove Sirocco's motivation for copulating with humans, or prevent access in other locations. Of greater concern was that Sirocco would be injured by someone attempting to divert his attack, which did occur on one occasion.

Sirocco's genes are well represented in the population. Due to this and his celebrity from the viral video, it was decided he would better serve the project as an ambassador bird. This has led to a change in his living circumstances. During breeding season he lives on Maud Island, away from the remaining population of kakapo (*S habroptilia*). The island includes two houses for rangers, volunteers and visitors. In the off season Sirocco is on display at various locations. It was while he was on display in November of 2011 at Zealandia a wildlife sanctuary in Wellington that a training program was implemented to address the problems with his sexual behavior.

Methods

Traditional approaches

When sexual behavior is exhibited by commonly kept companion parrot species, caregivers are often advised to do the following:

- Provide a less rich (carbohydrate dense, fatty) diet
- Maintain consistent light cycles
- Avoid access to nest like cavities
- Avoid reinforcing courtship behaviors
- Reduce the value of pair-like bonds with humans

Following these strategies can help prevent an increase in reproductive hormone output. However for Sirocco diet and light cycles could not be managed due to his living in his natural habitat. Even his enclosures for display were quite natural with constant access to natural light and vegetation to consume.

Because the males do not participate in nest building, nest like cavities are not triggers for sexual behavior. However males do engage in digging and maintaining bowls for booming. All that is required is for bowl building is access to soil in the enclosure or the island. This too would be impossible to manage.

Because kakapo (*S habroptilia*) will mate with many different females during one breeding season, pair like bonds are not forged with specific individuals. Males will mate whenever the opportunity presents itself. Therefore any interaction with humans had the potential to be of value to Sirocco.

Kakapo (*S habroptilia*) do not present the same courtship behaviors as other parrots. They do not regurgitate food for mates, participate in allo-preening or stay in close proximity to a specific individual. Bowl building and vocalizing for females appear to be the most significant courtship behaviors. Once a female is within range copulation occurs, without much more in the way of pre-cursors.

The unique natural history and living circumstances for Sirocco made it unlikely that triggers for reproductive behavior would be reduced. Therefore a different approach was considered.

The goal would be to train Sirocco to present behavior(s) that is incompatible with copulating with heads that could be reinforced with the opportunity to mate with a designated object. This would involve training him to interact with an object identified for copulation, identifying triggers and antecedents for sexual behavior to avoid creating undesired behavior, redirecting to acceptable behavior, and training a desired incompatible behavior.

Modal action patterns

Copulation is a modal action pattern. Modal action patterns are sometimes referred to as innate or hard wired behaviors. This means an animal does not need to have prior learning history to exhibit the behavior for the first time. 15 With the right triggers and motivation the behavior will be presented by the animal. However modal action patterns also have flexibility. For example predatory responses are modal action patterns, yet predators are not constantly predating. Predation occurs when the right triggers occurs, such as a fast moving prey item scurries by, and the animal is hungry. A lion may prefer sleeping mid-day after a morning meal, rather than exert the energy to chase a nearby resting antelope.

Modal action patterns are also modified by experience. For example Kakapo (*S habroptilia*) learn to boom more effectively over time and by listening to other males. Studies also show that stimuli that elicit modal action pattern responses can be altered or replaced. 16 In Sirocco's case his experience of copulating with heads is not genetically hard wired. He has learned this pairing via opportunity and experience.

Livestock are frequently trained to mount dummies for semen collection. This unnatural pairing prevents injury to females. Similar to livestock, it was theorized Sirocco's sexual behavior could be paired with another object.

Sirocco's comfort with people and the training environment fostered his receptiveness to positive reinforcement training. He responded immediately to small pieces of macadamia nut and pine nuts as reinforcers. He learned to target, station on a stump, step onto an arm, and hop from an arm to a stump within his first week of training. The target was used to train him to approach and interact with the object designated for copulation. Initially this object was a barn owl puppet.

During training sessions no sexual behavior was observed. Therefore the training with the puppet was primarily to pair known reinforcers (food) with the object and increase its value to Sirocco. After several sessions Sirocco would walk onto the owl puppet without hesitation.

Training incompatible behaviors

Training sessions also focused on identifying and training a behavior incompatible with climbing to mate with people's heads. Sirocco readily climbed to a stump for the opportunity to engage in a training session. With a long history of being reinforced for climbing on the stump, this quickly became a preferred activity. It was decided that stationing on a stump would be the designated incompatible behavior. Stump stations would be easy to create and establish at the different places in which Sirocco may encounter humans. Whether this was on Maud Island, while on exhibit or in off exhibit holding areas.

Making it easy for Sirocco to do the behavior was equally as important as a strong history of positive reinforcement with the behavior. Most stations included a log that could be easily climbed for access to the station.

Stationing on a log also made it more difficult for Sirocco to gain access to a gumboot to begin his climb to a person's head. Making it highly reinforcing and easy to do the desired behavior and difficult to do the undesired behavior were important elements to addressing the problem behavior.

Additionally it would be helpful to withhold the reinforcers for the undesired behavior. However in reality once the bird had access to a person's head, the mating action was self-reinforcing. Therefore preventing or redirecting the undesired behavior was critical. This meant people needed to be acutely aware of environmental triggers and body language that preceded attempts at copulation.

Triggers and antecedents for sexual behavior

In Sirocco's case sexual behavior was triggered by a variety of things. These were determined after careful observation and discussion of past occurrences of the problem behavior. As with other kakapo (*S habroptilia*) if Sirocco was on his bowl and booming, he was more likely to charge to attempt copulation. He was more likely to attempt mating behavior at night. Movement of people's boots also triggered a charge response. If a person stooped lower, he was more likely to attempt to climb to someone's head. Knowing these triggers helped prevent people from putting themselves in a situation in which Sirocco may attempt copulation.

Sirocco's body language also changed prior to charging people. When relaxed and comfortable the shape of his head and body tended to be rounded, his eyes were almond shaped and his weight was often distributed low over his feet. When preparing to charge, he would walk slowly at first with his head outstretched in front of him. His eyes were opened wider and his head feathers were no longer rounded. Once closer he moved quickly and charged towards boots. The slow stalking behavior was an easily observed precursor to potential undesired behavior. It was in these moments that caregivers could avoid doing anything that may trigger a charge (such as bending down or moving boots) and use a target to redirect Sirocco to a nearby station. Once on the station Sirocco could be reinforced with food or the opportunity to mate with the owl puppet.

Ideally the goal was for caregivers to notice Sirocco's behavior before he attempted to charge or climb to a head. This was to avoid teaching him to present undesired behavior first in order to have the opportunity to present desired behavior and get reinforced. To avoid this Sirocco needed to be cued to his station prior to charging.

Results

Sirocco typically showed a high level of motivation for participating in training sessions while living at Zealandia. Sessions would often continue for 60 minutes or more. At the end of each session Sirocco would climb down from his station and wait to be released into the off exhibit portion of his enclosure. Most evenings he would disappear into the foliage presumably on his way to the top of the hill in the enclosure. Evidence of bowl building was later discovered in that area.

One evening he stopped halfway up the hill squatted down and began booming. The training team stopped to observe for approximately 20 minutes. When one of the team members moved his boots, Sirocco charged down the hill and climbed to the ranger's head and began copulating. The owl puppet was presented on an arm and the bird stepped onto it. He then climbed from the owl to the second person's head. Another transfer was made to the puppet and Sirocco was held waist high sitting on the puppet. He attempted to climb to a head again but was unsuccessful; in that moment he redirected to the owl puppet and began copulating with it.

With just a small number of sessions there was evidence that the behavior could be quickly transferred to another object.

As mentioned in the Methods section, Sirocco successfully learned the behaviors most critical to address the problem behavior while at Zealandia. Shortly after that he was transferred to a holding area on Maud Island. The new environment caused a decrease in motivation for training initially. However he quickly learned a new station and a new behavior (moving sticks to simulate bowl tidying). Rangers also worked on training Sirocco to step from a tree onto an arm.

After three weeks of quarantine in the holding area, Sirocco was released to roam the 310 hectare island. He was not seen for several weeks. The rangers located him via telemetry and reported Sirocco responded well to an impromptu training session. He was also offered a Crocs brand shoe to which he responded by copulating with it.

2011-2012 has proven to be a non-active year for breeding due to low yields of the fruit that trigger breeding for kakapo (*S habroptilia*). Sirocco's motivation to copulate is likely reduced. He has not visited the human accommodations much. However in encounters with him he has been easily redirected to acceptable behavior. This low motivation is beneficial to training. It gives rangers the opportunity to reinforce desired behavior with a decreased likelihood that Sirocco will attempt copulation with human heads. This gives more opportunities to reinforce desired behavior under the conditions of living freely on Maud Island. Rather than trying to address the undesired behavior under the most difficult circumstances, it allows the rangers to work up to additional criteria of a more sexually motivated parrot in seasons to come.

Discussion

While behavior change technology and the science behind it apply to all species of animals, the unusual natural history of the kakapo (*S habroptilia*) meant modifications to techniques typically used with psittacine birds were required.

Kakapo (*S habroptilia*) are not social. They do not flock to feed, bathe, or vocalize. Although males do lek, the space between birds is quite significant and the males do not attempt to interact, other than to defend bowls. The males are not involved in nest building or care of the chicks. Allo-preening is not an activity in which they engage. This meant touch or companionship were not likely going to be valuable as potential reinforcers for desired behavior. Food was the main reinforcer used for training with the eventual goal that the opportunity to copulate would later also be used as a reinforcer. It was also noticed due to Sirocco's hand raising he still occasionally displayed a juvenile feeding response. This response could be initiated by touching parts of the beak. Once initiated he often sought more of this interaction. It was discussed this could be potentially used as a reinforcer when food loses value.

Kakapo (*S habroptilia*) are well adapted for a nocturnal lifestyle. This meant training sessions occurred at night with very little lighting. Because sexual behavior was less likely during the daytime, there was some benefit to several daytime sessions. Training could occur in locations during the day that could be problematic at night. This allowed opportunities to reinforce desired stationing in locations that might otherwise trigger attempts to mount.

Similar to other parrots, kakapo (*S habroptilia*) do use their feet and beak to climb. Although their feet are zygodactyl, they do not grasp food in their feet in the same manner as other parrot species. Instead of holding food up to their mouths, the foot is placed on the food and held down for the parrot to use as leverage when stripping off pieces of food or masticating to absorb juices. This is much more similar to some raptor species as opposed to parrots in terms of the behavior's topography. In most training scenarios when a parrot puts a piece of food in its foot, it can indicate either the piece utilized was too large or that the bird's motivation for the reinforcer is waning. This mean some body language that indicated level of motivation was different for kakapo (*S habroptilia*) compared to other psittacines. Level of interest was evaluated based on Sirocco looking at the trainers for more food, or moving towards

a trainer. When satiated he often offered a chortling type vocalization or hopped to the ground to wander off.

The kakapo's (*S habroptilia*) diet is highly fibrous and low on protein. They consume a large amount of vegetation. Natural vegetation was used as reinforcers for training. However it was known that some of the items typically used in traditional parrot training as reinforcers also held value for kakapo (*S habroptilia*). This included macadamia nuts and pine nuts. Nut choices were limited due to a kakapo death that was attributed to aflatoxins.

Kakapo (*S habroptilia*) are flightless primarily ground dwelling parrots. This meant training areas had to accommodate a ground dwelling bird. It also meant kakapo (*S habroptilia*) are comfortable on the ground. Other parrot species tend to prefer perching in elevated areas. A high level of comfort on the ground also made it more likely the bird would aggress or attempt sexual behavior when on the ground as opposed to most other species.

During the training process it was learned that kakapo (*S habroptilia*) can copulate for 40 minutes or more. It became clear that holding an owl puppet for reinforcing the presentation of desired behavior would be unrealistic. A more practical solution would be to provide an object that could be left with Sirocco or carried off. Sirocco had a known history for taking Crocs brand shoes from the ranger/volunteer accommodations on the island. It was decided that the owl puppet would be replaced by Crocs shoes.

Because Sirocco is free to roam Maud Island during breeding months, rangers cannot predict when Sirocco may visit a house. Having stations ready and waiting at convenient locations and reinforcers ready and available at all times is required in case of an impromptu visit. Unlike the predictability afforded with companion animals, training sessions can happen at any time or may not happen for weeks.

After the success of redirecting Sirocco's sexual behavior to another object, it was frequently asked why the focus was not on training him to interact with a female. Lack of genetic diversity has been identified as a critical factor in the loss of eggs and chicks each breeding season. The population is highly managed to maintain a high level of genetic diversity. Sirocco's genes are well represented and not needed in the breeding community. It has been decided by the team that his role as an advocacy bird better serves the conservation efforts at this time.

Summary

Sirocco's training is still a work in progress. Initial results have been extremely successful. Sirocco learned behaviors that are useful for managing him while on display and for safely interacting with him while he is free to roam Maud Island. A plan has been implanted to address his undesired sexual behavior that involves reinforcing presentation of an incompatible behavior with the opportunity to copulate with a designated object. Elements of this have already been successful (copulating with a new object, targeting, stationing). The scenario that has not occurred is for a sexually motivated Sirocco to approach a human; the person uses a target to redirect him to a station, and then reinforces Sirocco for stationing by offering a Crocs shoe for copulation. Due to the low motivation for breeding this season, Sirocco has not sought out humans for mating. This however has allowed the behaviors he has learned to build more reinforcement history, under less sexually charged circumstances. This helps make it more likely he will present the desired behaviors as the criteria of increased motivation is raised. Sirocco's motivation to copulate is expected to be higher in 2012-13 season as it is predicted to be a breeding year for kakapo. Given the success of the training to date, it is anticipated that Sirocco will present the desired response.

Addendum

In November of 2012 training to address the behavior problem was initiated again. Sirocco's motivation to copulate was observed to be much stronger than in 2011. The rangers had numerous opportunities to successfully cue Sirocco for desired behavior and reinforce with the opportunity to mate with a shoe. This was practiced initially under less triggering circumstances to build reinforcement history. Criteria was raised by adding known triggers such as movement of boots, and easy access to people's heads. Sirocco was successfully redirected to acceptable behavior when pre-cursors of mating behavior were observed. However once copulating with a head it was difficult to redirect his attention to another behavior. For this reason it is important for handlers to be observant of Sirocco's body language and cue for acceptable behavior before he is fully engaged in mating behavior. The training strategy has been successful in significantly reducing aggressive behavior associated with attempts at copulation with human heads.

Sirocco's training has also progressed to include many behaviors useful for medical care. Via positive reinforcement training he has learned to allow handling and restraint, wing manipulation for transmitter changes without restraint, visual and tactile ear examination, and touching and manipulation of the cloaca. Future goals include cloacal sampling for routine health checks as well as eye swabbing without restraint.

Sirocco was on display in 2012 and it was reported that his behavior was much improved since a training program was implemented.

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