Cat righting reflex

The **cat righting reflex** is a cat's innate ability to orient itself as it falls in order to land on its feet. The righting reflex begins to appear at 3-4 weeks of age, and is perfected at 7 weeks[1]. They are able to do this as they have an unusually flexible backbone and no functional clavicle (collarbone). The minimum height required for this to occur in most cats (safely) would be around 1 m (3.3 ft). Cats without a tail also have this ability, since a cat mostly moves its hind legs and relies on conservation of angular momentum to set up for landing, and the tail is in fact little used for this feat.[2]

Contents

Technique

After determining up from down visually or with their vestibular apparatus (in the inner ear), cats manage to twist themselves to face downward without ever changing their net angular momentum. They are able to accomplish this with these key steps:

1. Bend in the middle so that the front half of their body rotates about a different axis than the rear half.
2. Tuck their front legs in to reduce the moment of inertia of the front half of their body and extend their rear legs to increase the moment of inertia of the rear half of their body so that they can rotate their front half quite far (as much as 90°) while the rear half rotates in the opposite direction quite a bit less (as little as 10°).
3. Extend their front legs and tuck their rear legs so that they can rotate their rear half quite far while their front half rotates in the opposite direction quite a bit less.

Depending on the cat's flexibility and initial angular momentum, if any, the cat may need to repeat steps two and three one or more times in order to complete a full 180° rotation.[3][4][5]

Terminal velocity

In addition to the righting reflex cats have a number of other features that will reduce damage from a fall. Their small size, light bone structure, and thick fur decrease their terminal velocity. Furthermore,

fall. Their small size, light bone structure, and their fur decrease their terminal velocity. Furthermore, once righted they may also spread out their body to increase drag and slow the fall to some extent.[6] A falling cat's terminal velocity is 100 km/h (60mph) whereas that of a falling man in a "free fall position" is 210 km/h (130mph). At terminal velocity they also relax as they fall which protects them to some extent on impact. However, it has been argued that, after having reached terminal velocity, cats would orient their limbs horizontally such that their body hits the ground first.[7]

Injury

Using their righting reflex theory, cats can often land uninjured. This is, however, not always the case, and cats can still break bones or die from falls. In a 1987 study, published in the *Journal of the American Veterinary Medical Association*, of 132 cats that were brought into the New York Animal Medical Center after having fallen from buildings, it was found that the injuries per cat increased depending on the height fallen up to seven stories but decreased above seven stories.[8] The study authors speculated that after falling five stories the cats reached terminal velocity and thereafter relaxed and spread their bodies to increase drag. However, an alternative interpretation which came out of internet chat[8] of the study would be that upon an excess of seven stories the cats experience a higher fatality rate which precludes the owner from bringing them in for medical attention. Although scientists in Massachusetts have recently discovered that the cat's ability to spread its legs out to decrease drag when reaching terminal velocity would explain the decreased injuries sustained above seven stories because they wouldn't reach terminal velocity before then. Professor David Stevenson said "we simulated the cat's weight and size and found the terminal velocity to be 60mph which would more than likely result in severe injury or death to the cat when falling from this speed, but once we took into account the cat's ability to right its self and spread its body out this reduced the terminal velocity to only 53mph. this 7mph difference is massive and would almost certainly ensure the cat's survival. There however is always the possibility that the cat may not manage to right itself so this is far from a conclusive experiment and we do not condone the throwing of cats from anything".

See also

- Falling cat problem: the mathematical problem of explaining the physics of the cat righting reflex
- Buttered cat paradox
- High-rise syndrome

References

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2. Huy D. Nguyen. "How does a Cat always land on its feet?". Georgia Institute of Technology, School of Medical Engineering. Retrieved 2007-05-15.
3. Hardy Fink. "An insight into the Biomechanics of Twisting". Archived from the original on 1998-05-28. Retrieved 2007-12-26.
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5. Kane, Thomas; Scher, M. P. (1969). "A dynamical explanation of the falling cat phenomenon". *International Journal of Solids and Structures*. **5** (7): 663–670. doi:10.1016/0020-7683(69)90086-9.
6. "Vertebrate Flight: Gliding and Parachuting". Retrieved 2008-06-04.
7. Feline high-rise syndrome: 119 cases (1998-2001). Vnuk D et al., J Feline Med Surg. 2004 Oct;6(5):305-12 (http://www.ncbi.nlm.nih.gov/pubmed/15363762)
8. ^ ***a*** ***b*** "The Straight Dope: Do cats always land unharmed on their feet, no matter how far they fall?". Retrieved 2008-06-04.

Further reading

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External links

- Why cats land on their feet (http://www.petplace.com/cats/why-cats-land-on-their-feet/page1.aspx#)
- National Geographic video on the cat righting reflex (http://video.nationalgeographic.com/video/player/animals/mammals-animals/cats/cats_domestic_ninelives.html?fs=animals-panther.nationalgeographic.com)
- The miracle of the falling cat (http://scienceblogs.com.br/brazillion/2009/06/the_miracle_of_the_falling_cat.php)

fr:Réflexe de redressement du chat