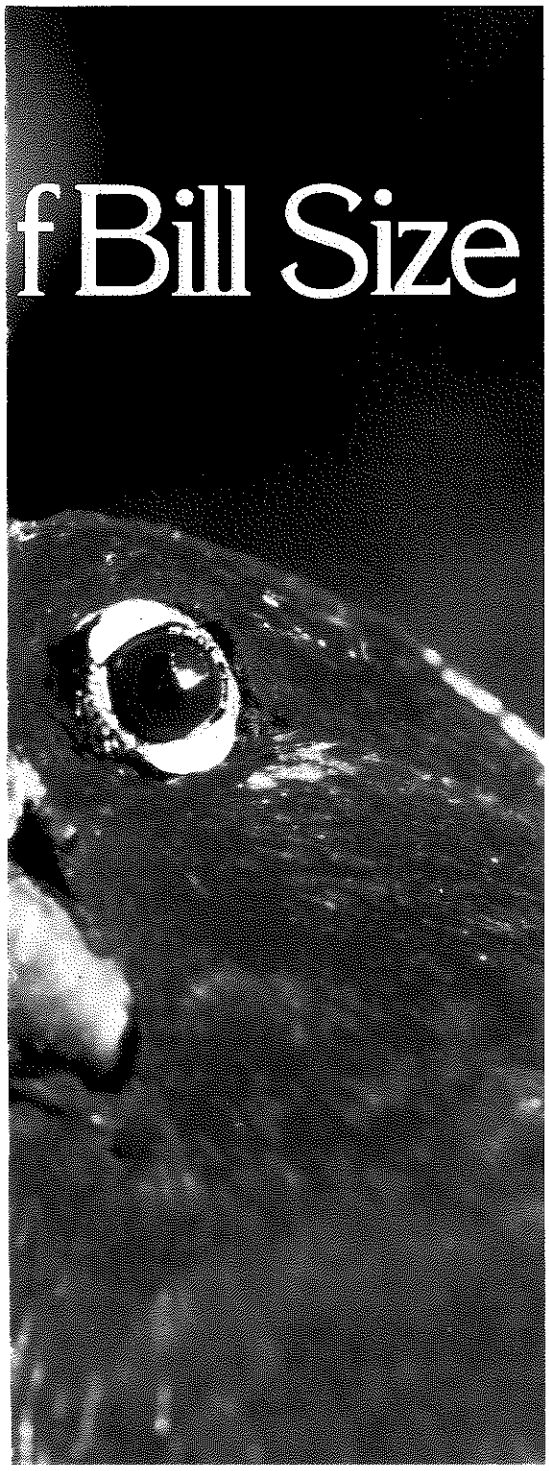
Cracking the Problem o

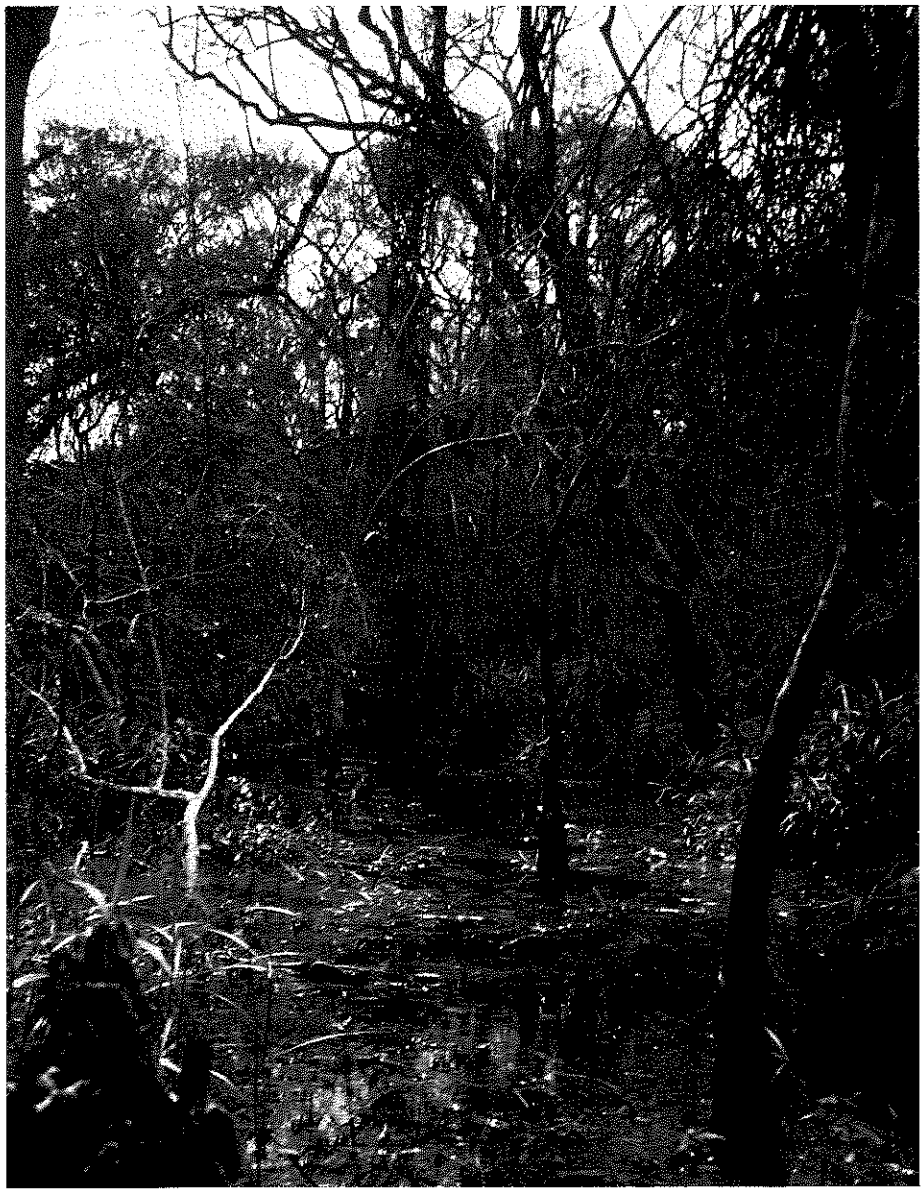
The large and small bill forms are clearly seen in this photograph of a pair of Black-bellied seedcrackers. Tom and Paige Smith seek the ecological and evolutionary reasons for this variation.

f Bill Size

In the rainforests of Cameroon, and at Riverbanks Zoo, researchers study the unique variation in bill size of the Black-bellied seedcracker.

Article and photographs by TOM and PAIGE SMITH





The Black-bellied seedcracker's breeding period coincides with the rainy season in West Africa (September to November), when food is abundant and it is easier to raise young.

In any given region in Africa, seedcrackers present two distinct bill forms: large and small, with no individuals with intermediate-sized beaks. A comparable phenomenon in humans would be if there were adults from four to five feet tall and six to seven feet tall with no one between five and six feet.

A DENSE MIST hangs in the air and we can barely make out the narrow channel as we paddle our dugout through the thick tangle of vines. Like cathedral walls enormous trunks of trees rise at our sides. Overhead the dawn silence is broken by the defensive "coughs" of talapoin monkeys as they jet across the canopy above us. In the distance the faint cries of African grey parrots can be heard as they leave their roosts. It is morning on the Nyong river.

It's a 40-minute trip to our first line of mist nets, an appropriate name for these 12-meter-long nets. When open they are nearly invisible in the dawn light. We must stand in the dugout to open them. The nets when open form a seven-foot-high curtain. Birds are captured when they fly into the nets and become tangled in the light nylon mesh. After the nets are open we move on to the next line, but will return in a half hour to collect our bounty.

In 1983 we left the comforts of Berkeley, California and established a primitive field camp in the remote rainforests of Cameroon, West Africa. Here we lived in tents for two years with little more contact with the outside world than a radio. Our closest neighbors lived in a small mud hut village a kilometer away. Here all long distance calls are free; they are pounded out on a drum. We came to study a small finch, the Black-bellied seedcracker. A rather drab name for this spectacular crimson bird. It was not, however, the delight in its color which drew us here. It was rather our interest in their unique variation in bill size.

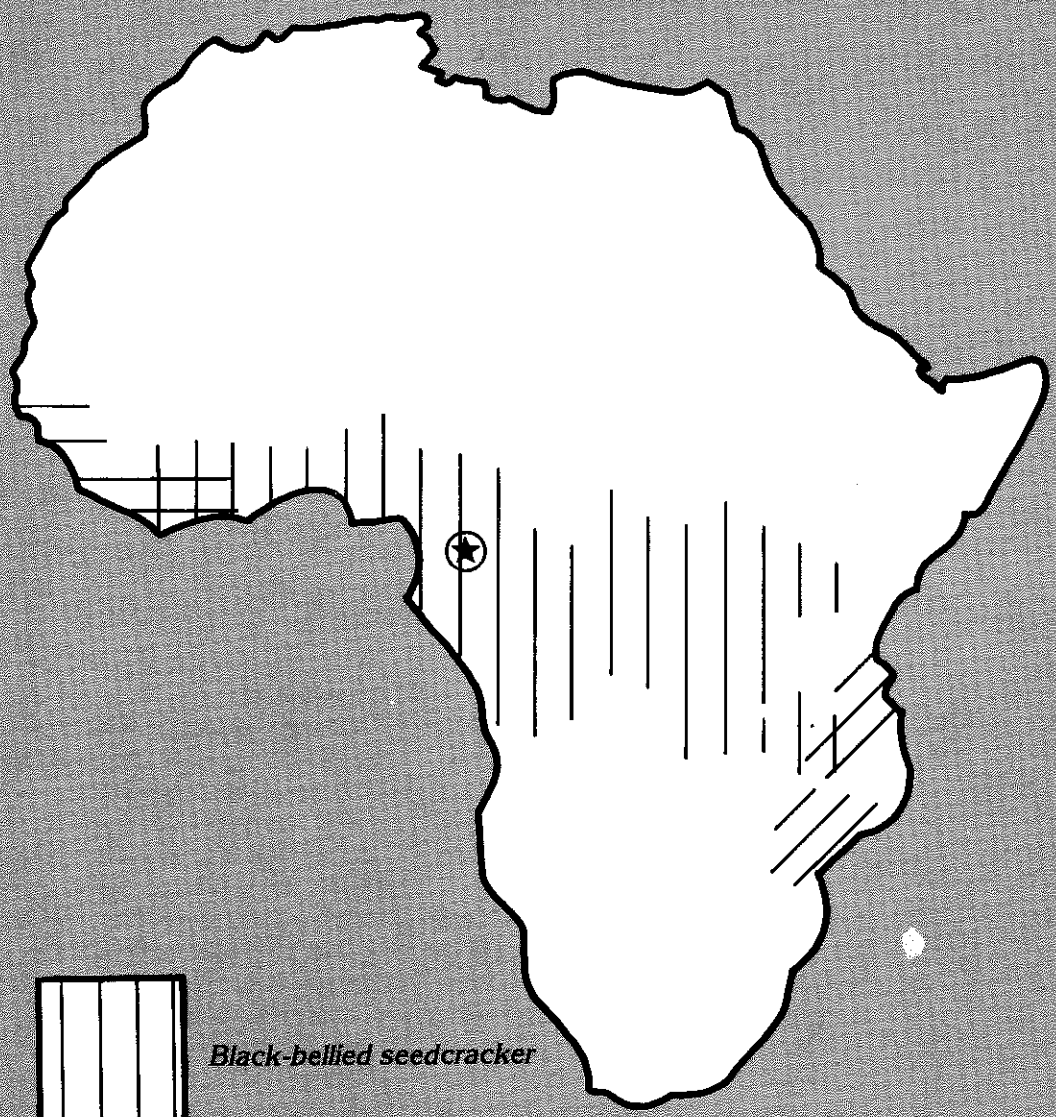
The seedcracker, unlike any of the more than 9,000 bird species on the planet, is like two species rolled into one. In any given region in Africa one finds two distinct bill forms: large and small, with no individuals with intermediate-sized beaks. Furthermore, the difference is not sex related. Males and females may be either small or large billed. A comparable phenomenon in humans would be if there were adults four to five feet tall and six to seven feet tall with no one between five and six feet. For over half a century bill variation in the seedcracker has baffled biologists. The two forms are so different in bill size, some biologists believed they were different species, but reports of the two forms interbreeding suggested they were a single species. With financial assistance from the National Geographic Society and National Science Foundation we hoped to discover the ecological and evolutionary reasons for the variation.

The seedcracker, like many tropical species, is a specialist. It lives only in swamp forests feeding on the hard seeds of sedges—a grass-like plant found in moist areas. It times its breeding to coincide with the rainy season (September to November), when food is abundant and it is easier to raise young. The Nyong river responds to the increase in rainfall by rising 20 feet, flooding the forest and not infrequently our camp. Conducting research is difficult this time of year. Mosquito densities increase tremendously, making it difficult to sit in a blind for hours at a time recording behavior. Malaria and a wide assortment of other tropical diseases transmitted by biting insects are also cause for concern. A wide assortment of poisonous snakes including mambas, cobras and vipers which make their home here are more common this time of year. We respect them for the important ecological role they play. But we give them plenty of room when we meet on a trail.

Life isn't easy for breeding seedcrackers either. Less than 15 percent of the pairs which try to nest succeed in fledging young. Nest predation is typically very high in the tropics. Here a high species diversity of snakes, predatory birds and mammals and even ants take their toll on eggs and nestlings.

We found small-billed birds mated randomly with respect to bill size. In addition, biochemical analysis

The ranges of African seedcrackers: Black-bellied *(Pyrenestes ostrinus)*, Crimson (*P. sanguinus*) and Lesser (*P. minor*). The star indicates the area of the authors' field research.



Black-bellied seedcracker

Crimson seedcracker

Lesser seedcracker

Photograph by Tim Sales

The authors at work in their Cameroon field camp. During the rainy season, when the Nyong River rises twenty feet, flooding the forest (and not infrequently the camp), dugout canoe is the primary means of travel.

of tissue samples showed the bill types to be genetically the same species. The actual genetic mechanism which gives rise to two forms, however, is still a mystery. But through our collaborative efforts with the Riverbanks Zoo we are getting closer to an answer.

So what good is it to have two bill sizes? And why aren't there birds with intermediate-sized beaks? Sometimes asking the question why in biology is misleading. Not all traits have a function. Some traits may simply be present because they occurred in an ancestor and are carried along as extra baggage. In birds, however, there is a close relationship between bill size, food habits and survival. Seedcrackers are no exception. Seedcrackers specialize on two types of seeds – a hard seed on which large-billed birds specialize and a soft seed on which the small-billed bird specializes. Each beak type feeds more efficiently on its respective seed. The question whether survivorship changes when a given type of seed declines in abundance is one of many questions we are still examining.

Understanding what maintains variation in populations is important because it helps us understand ourselves. A large component of human disease has a genetic cause. In addition, by studying a single species we are able to examine in depth how tropical rainforests are put together. African rainforests, while comprising less than five percent of the total land mass of Africa, contain over half the species of plants and animals on the continent. Sadly, the majority of West African rainforests are expected to be cut down by the end of the century. For conservation to be effective, we must understand the components of these unique ecosystems. Research on seedcrackers is a small part of this effort. □

(See page 10 for a related article on Riverbanks' contribution to seedcracker research.)