# Is the LCP Superfund Site an Ecological Trap? A Case Study Using the Clapper Rail


**K.F. Gaines[1], J.M. Novak[1], and G.L. Mills[2]**

[1] Eastern Illinois University, Department of Biological Sciences, Charleston IL 61920

[2] Savannah River Ecology Laboratory, Aiken SC 29802


## Why LCP May Be an Ecological Trap

The LCP Chemical plant located in the center of the Golden Isles region of coastal Georgia (Fig. 1) was convicted of dumping 150 tons of mercury into the surrounding tidal marshes, between the mid-1980s and its closure in 1994. LCP purchased a type of PCB called Aroclor 1268 from the sole manufacturer, which only produced a limited amount of this particular Aroclor (Kannan *et al.* 1997). This PCB has been found at very high levels in the marshes directly adjacent to LCP (Novak *et al.*, In Press), thus making it a direct fingerprint to the point source of the pollution. Gaines and colleagues assisted the US Fish and Wildlife Service (USFWS) to document the extent of the damage to wildlife resources using the Clapper Rail (*Rallus longirostris*) as an indicator of ecosystem health (Gaines 1999, 2000). Although this research helped the USFWS quantify damage to the ecosystem, it left many unanswered questions. Specifically, it inspired the hypothesis that the LCP marsh may be what is commonly referred to as an "ecological trap". That is, previous studies have shown that LCP marsh has excellent habitat for Clapper Rail courtship and nesting (Gaines *et al.* 2002, Cumbee 2003), thus luring birds in to nest; but the high levels of contaminants may be reducing or even possibly eliminating the number of successful nests (i.e. chick survival to the next generation to breed). **The purpose of this study** is to determine if the marshes associated with the LCP contamination are indeed ecological traps.

## OBJECTIVES

The rail's strong fidelity to their breeding grounds (Zembal *et al.* 1989) and predictable diet (Terres 1991) makes it an ideal organism to study the movement and fate of contaminants in disturbed ecosystems. This species is an integral part of the salt marsh ecosystem and feeds relatively high on the food chain. Hence, the exploration into whether the marshes associated with the LCP chemical plant are ecological traps give insight beyond the health of the birds themselves. To explore this question, the **specific objectives of this study** are to:

(1a) Determine if Clapper Rails currently nesting in the LCP marsh either nested or hatched from that location the previous year.
(1b) Determine if Clapper Rails currently nesting in nearby reference marshes either nested or hatched from LCP the previous year. This will allow the qualification that individuals who utilize LCP do survive and have fidelity to the marsh.

## METHODS: PCBs as a Site Fidelity Signature

Objective 1a,b: Clapper Rails only molt certain feathers once per year at the end of the nesting season (Fig. 2), therefore feathers were collected and analyzed for the PCB Aroclor 1268 to determine if that animal nested or hatched from the LCP marsh the previous year. In a pilot study, feathers collected from LCP and a control site were washed with Acationox ® to remove exogenous material. PCBs were extracted from feathers based on standardized EPA methods (EPA Method 3550B) modified by Dauwe et al. (2005).

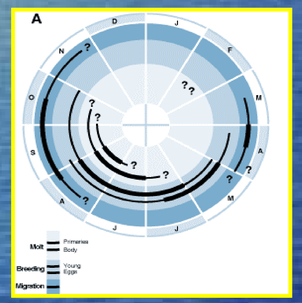



**Fig 2:** Annual cycle of breeding, molt, and migration of the Northern Clapper Rail (A) in Virginia as described by "The Birds of North America". Prebasic I molt partial; does not include rectrices or remiges. Commences when flight-feathers are about half unsheathed. Completed between late Aug. and Nov. on Atlantic Coast of U.S.

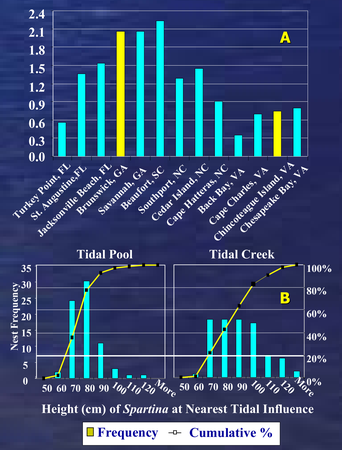
## PREVIOUS WORK: Clapper Rail Natural History

Most work describing the natural history of the Clapper Rail on the Atlantic coast was performed and documented by Meanley (1985). However, due to the large difference between the tidal amplitude (Fig4A) between Brunswick, GA and Chincoteague Island, VA, Clapper Rails choose nest sites very differently. Specifically, the difference in height of the *Spartina* vegetation between tidal creek and tidal pool location is not as pronounced as other Atlantic coastal regions, giving a larger area for Clapper Rails to nest (see Gaines *et al.* 2003 for further explanation).

We documented a strong utilization of tidal pool nesting sites (Fig. 4B), which has not been recorded for the Atlantic coast. Clapper Rails possibly use these sites since they are close to food resources and to avoid nest flooding from high tides.

Understanding how Clapper Rails utilize their nesting and foraging habitat have important implications regarding their potential to contaminant exposure and subsequent probability that the LCP Superfund site may serve as an ecological trap.

**Fig 4:** (A) Tidal amplitude (m) and (B) vegetative structure of Clapper Rail nest sites in Brunswick, GA, USA.




## PREVIOUS WORK: Quantifiable Damage

| ECOTOXCIOLOGICAL ENDPOINT | PUBLICATIONS |
|---|---|
| DNA Strand Breakage | Novak *et al.* In Press (see adjacent poster) |
| Eggshell Integrity | Rodriguez-Navarro *et al.* 2003 (see adjacent poster) |
| Chick Neurological Damage | Studies not complete (see Fig. 3) |
| Chick Bone Structure Abnormalities | Rodriguez-Navarro *et al.* 2006 |



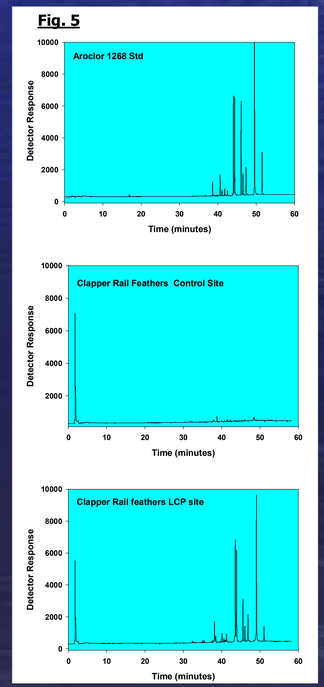
**Fig. 3:** Typical posture of chicks hatched from the LCP Superfund site contaminated with PCBs, mercury and other metals (left) compared to hatchlings from eggs collected from nearby (<7km) control sites (right).

## RESULTS

Detector response (Fig. 5) to feathers processed for PCB analysis using gas chromatography showed that Clapper Rail feathers collected from birds inhabiting LCP had measurable levels of Aroclor 1268, while those collected from Brunswick control sites did not as compared to known standards (std).


Fig. 1: LCP Superfund site

**Fig. 5**




## Additional Measures

Two additional objectives will lend insight to quantify the degree to which Clapper Rails are using the contaminated marsh during and immediately after the fledging period, thus further investigating the whether LCP may be an ecological trap.

**Objective (2):** Determine the age structure of the nesting population and compare it to an established reference sites (near and far from LCP). This will determine if older birds are consistently reusing the site.

When Clapper Rails are collected, the color of their legs will be quantified using scientifically established color charts to determine their age (1st year breeders vs. 2nd year breeder or older). These leg-color methods have been used in other studies (Meanley 1985, Eddlemen and Conway 1998) on the east coast of the United States and qualitatively been validated for the LCP site from a previous collection of birds from LCP (Gaines unpublished data). Younger and older rails can be differentiated by internal examination of the bursa (Bellamy and Mohamed 1982); however, there are no published studies concerning the Clapper Rail. Subsequently, additional birds (35) have been collected during the hunting season to establish a large enough sample size for proper statistical analyses and subsequent publication. This information is greatly needed in the literature to limit collections of Clapper Rails solely for age determination in the future.

**Objective (3):** Determine the survivorship of broods from call surveys and compare it to established reference sites (near and far from LCP). This will provide immediate insight as to whether the same numbers of individuals produce successful broods in the contaminated marsh as compared to another comparable marsh.

Call surveys are a proven method for comparing Clapper Rail populations between sites. Both adults and offspring are extremely vocal and will eagerly respond to tapes played in the field (Eddleman and Conway1998). We have already successfully used these methods at LCP and reference locations. However, we did not set up surveys to specifically compare those sites post-breeding, which is the information needed to determine if LCP has as many successfully fledged chicks as other reference sites.

## Literature Cited

Please see handouts for literature cited and reprints of our work.

## Acknowledgements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