A PRELIMINARY LIST OF THE COLONIES OF TREE SNAILS, LIGUUS FASCIATUS, IN THE AREA OF DADE COUNTY, FLORIDA, SOUTH AND WEST OF MIAMI[1]

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In recent years a new threat to the natural environment has appeared in southeastern Florida. Areas of the rocky ridge southwest of Homestead which seemed safe from exploitation for years to come are now being intensively farmed by a technique called "rock farming." This consists of breaking up the surface of the Perrine rockland with bulldozers and other heavy machines and using the resulting fragments of limestone to support various winter crops. The native vegetational associations - largely fire-adapted xeroseres - cannot survive this massive change in the substrate, and even if the "rock farms" are abandoned the original pinelands will have disappeared over considerable areas.

In general the "rock farms" have not yet encroached upon the hardwood hammocks (subtropical jungle hammock associes and associations), and in places the stands of broad-leaved trees are isolated in broad cultivated tracts. This temporary reprieve is due only to the difficulty of clearing the tough hammock vegetation even with heavy equipment. Eventually, these unique patches of woodland, which stood originally as isolated islands of tropical forest ... the dry pine forests and gladelands, will be cleared. They have already been almost completely destroyed in the vicinity of Miami (Young, 1951) and to the north (Young, 1958). The dense human population of the southeastern ridge had already doomed the jungle hammocks and their associated faunas, but the "rock farms" have accelerated the process of destruction.

My concern with the jungle hammocks centers principally around the colonies of tree snails, Liguus fasciatus (Müller), which most of them once contained. A very few hammocks are preserved in county parks and private estates, but even in these the tree snails seem to be dying out. In view of this situation, I feel we should try to salvage all the data possible on the biology of the hammocks. Competent malacologists and others should make scientific collections from as many of the remaining hammocks as can be reached. If the hammocks cannot be saved, preserved material can at least be made available for future study.

The collections of Liguus presently in museums are largely unsuitable for certain types of investigations because of the way in which the material was collected. That is, random samples of the

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populations are needed to make certain kinds of comparisons between different localities. Selected series of "pretty" shells are not enough. Each of the hammocks which still supports tree snails has a distinctive colony which differs from others either in composition or structural features of the shells. These differences reflect not only different ecological conditions in different locations, but also the fact that each hammock represents a different degree of isolation both in time and space. We may never be able to obtain sufficient material of Liguus to make studies such as those on Partula and Achatinella, but at least we can try to save a little for future students.

The following preliminary list includes the hammocks known to have supported colonies of Liguus in the area of Dade County south and west of Miami and some which may have supported Liguus. Other hammocks and unknown colonies of tree snails should be searched for throughout the area. For convenience, I have divided the known localities into groups on the basis of the pineland "islands" with which they are associated. These "islands" are not now surrounded by water since the drainage of the Everglades, but they were formerly separated by flooded transverse glades (drainage ways of the Everglades across the eastern rock ridge or rim). To locate "islands" use the "Official Map of Dade County, Florida, 1949" (scale 10,000 feet to 1 inch) which may be obtained for a nominal sum from the Biscayne Engineering Company of Miami. The boundaries of the "islands" are indicated by dashed lines on this map - marking the boundaries of the pinelands which also correspond to the rocklands. The hammocks are or were mostly around the edges of the "islands" although there are numerous exceptions. Aerial photographs of the USDA, Production and Marketing Division, for Dade County (1938 and 1953) show many of the hammocks or the remnants of them.

Since the present list is preliminary, I have not attempted any analysis of the composition of the tree snail colonies. Where a colony is indicated as "pure" the name of the color form (Clench and Fairchild, 1939) of L. f. roseatus is given. In the mixed colonies, unclassifiable forms are nearly always abundant indicating interbreeding between the various color forms which occur in pure colonies and may thus be assumed to represent genetically pure lines.

1. Brickell Island - The large area of rocky pineland bounded on the north by the Miami River and its transverse glade inland, on the east by the Silver Bluff shoreline, on the west by the Everglades, and on the south by the transverse glade and stream of Snapper Creek.

   The stands of the subtropical jungle hammock associes were largely peripherally distributed around the edges of the island as observed elsewhere. The hammocks of record were located as follows:

   1a. Edges of Miami River and its transverse glade inland:

   North end of Brickell Hammock - extending inland along river for about 2 miles. Old records of Liguus from as far west as area of F. E. C. Railroad and river (vicinity of SW 2nd Avenue). 54-41, Sec. 1. (Young, 1951).

   Second growth hammock on bluffs at about SW 6th Street, west of 3rd Avenue. No positive records, but possibly material in Simpson Collection. 54-41, Sec. 1.

   Hammock on low bluffs at SW 7th Avenue and 4th Street near Ada Merritt School. No records, but probably supported Liguus. 54-41, Sec. 1 (Young, 1951).

   Hammock along low bluffs west of NW 12th Avenue. Fragments only of Liguus. 53-41, Sec. 35. (Young, 1951).

   Lawrence Park Hammock on low bluffs along river west of NW 17th Avenue. Mixed colony. 53-41, Sec. 34. (Young, 1951).

Head of Miami River Hammock, on edge of pinelands, near South Fork of Miami River just east of N.W. 27th Avenue. Mixed colony. Liguus formerly extended into cypress trees and other trees along edge of River. 53-41, Sec. 34. (Young, 1951).

Hammock fringe along edge of pinelands west of 27th Avenue north of N.W. 7th Street. No records of Liguus, but may have supported them prior to clearing in about 1920-21. Possibly "Elizabeth Grove" in Simpson Collection. 53-41, Sec. 33.

Hammock on mound-like rise along edge of pinelands at N.W. 4th Street about 50th Avenue. Cleared, but with remnants of hammock trees - possibly once supported Liguus. 54-41, Sec. 6. (Young, 1951).

Hammock at edge of pinelands, west of 58th Avenue, south of N.W. 7th Street. Pure colony of elliotreutus. 54-40. Sec. 1. (Young, 1951).

Oak Hammock along edge of pinelands west of 67th Avenue. Probably never supported Liguus - possibly succession after fires were controlled. 54-40, Sec. 3.

1b. Hammocks on Indian mounds in Everglades near Brickell Island:

Flagami Hammock. Pure colony of lossmanicus. 54-40. Sec. 2, possibly into Lot 2. (Young, 1958).

1c. Hammocks in Everglades west of Brickell Island:

Hammock on Bird Road at S.W. 72nd Avenue, N.W. Corner. Pure colony of lossmanicus. 54-40, Sec. 14.

1d. Hammocks within the pinelands, south of Coral Gables canal:

Small Oak Hammock at Red Road just south of Coral Gables canal. (No Liguus, fide Ralph Humes). 54-41, Sec. 18.

Oak Hammock just south of University of Miami. Pure colony of lossmanicus. 54-41, Sec. 19.

? Hammock in vicinity of Coral Gables canal and U.S. Hgw. 1. Pure colony of lossmanicus. 54-41, Sec. 20?

? Hammock on Hardee Drive west of Red Road. Possibly supported Liguus. 54-40. Sec. 25.

1e. Hammocks along edge of Snapper Creek glade and stream:

Edge of glade Hammock, north of U.S. Hgw. 1, at Old Larkins (now South Miami). Possibly supported Liguus. 54-40, Sec. 36.

Edge of glade Hammock south of U.S. Hgw. 1, at Old Larkins (now South Miami). Pure colony of lossmanicus. 54-40, Sec. 36.

Western portion of Matheson Hammock. Mixed colony. 55-41, Sec. 6.

1f. Hammocks on or near the Silver Bluff shoreline along the eastern edge of Brickell Island:

Brickell Hammock - extended from edge of Miami River S.W. along Silver Bluff cliffs to 54-41, Sec. 16, and was probably continued by a fringe of hammock continuously to Cocoanut Grove. Hammock developed on Rockdale fine sand-limestone complex on top of bluffs along Biscayne Bay, probably spreading inland into pinelands when fires were infrequent and contracting at other times. (Young, 1951).

South Brickell Hammock - possibly a fragment of Brickell proper, but seemingly developed around pockets in the pinelands just west of the Silver Bluffs. Mixed colony of Liguus. 54-41, Sec. 15.

Cocoanut Grove Hammock - Hammock along bluffs of Silver Bluff shore from vicinity of Dinner Key southwestwards. Some modified hammock remnants east of Cutler Road south of Cocoanut Grove. Fragments of Liguus found by Ralph Humes in 1935 on Monroe Estate.

Twin Hammocks - two small hammocks in pinelands back from Silver Bluff shoreline, developed around potholes? Pure colony of lossmanicus. 54-41, Sec. 32; developed on Rockdale fine sand-limestone complex. (Young, 1951).

Matheson Hammock and associated hammock remnants along Silver Bluff shoreline. 55-41, Sec. 6. Hammock developed in deposits of Dade fine sand along bluffs and inland west of Cutler Road. (Large cypresses visible from Red Road were probably in glade west of Matheson.) Mixed colony of Liguus; some extra-areal forms possibly introduced.

Snapper Creek Hammock - partly developed along Silver Bluff shoreline, partly on edges of stream on deposit of Dade fine sand extending inland along Snapper Creek. Mixed colony. 55-41, Sec. 7.

Note: The development of Brickel and Matheson Hammocks seems to be explained by their topographic position in relation to fire protection. Brickell was on relatively high bluffs, and Matheson Hammock was located in a sort of redoubt between the Silver Bluff shoreline and the Snapper Creek glade. Matheson Hammock may have extended down to the present Snapper Creek Hammock area at one time.

2. Larkins Island. - Pinelands west of the north fork of Snapper Creek glade and between it and middle fork. (South Miami on south edge).

   Several oak hammocks on glade edges. No records.

3. Upper Snapper Creek Island - Pinelands west of middle fork of glade and north of main Snapper Creek Glade:

   ?Low Hammock - 1.5 miles west of Larkins. Pure colony of lossmanicus. Not now definitely located. Perhaps at Sunset Drive and Palmetto Road. 54-40, Sec. 26.

   Upper Snapper Creek Hammock - large oak-tropical hardwood hammock on SW edge of pinelands in 54-40. Secs. 33-34. Liguus in mixed colony. (Now partly a Boy Scout Camp area).

   Note: Upper Snapper Creek Hammock may be developed on Dade fine sand at the edge of the pineland island. A shallow glade in Sec. 22 may have originally separated this portion from the main pinelands.

   ?Small oak hammocks along glade edges - several patches are still evident. No records known.

   ?Hammocks on elevated areas in Snapper Creek glade near Island: One fairly well developed hammock with a cypress fringe indicating the original isolation occurs in 54-40, Sec. 32, just SW of Upper Snapper Creek Hammock. No records.

   (See also West Kendal Island which is closely associated with Upper Snapper Creek hammock system).

4. North Cutler Island - Pinelands between Snapper Creek and Cutler Creek bounded on east by Silver Bluff shoreline and on west by north fork of Cutler Creek glade. Some of the highest ground on the ridge (over 10 feet elevation at rock surface) lies at the north end of this island:

   Snapper Creek Hammock - south side of Snapper Creek. The hammock is developed on deposits of Dade fine sand along the south edge of creek also. Probably originally extending to the Silver Bluff shoreline and inland along the stream. The higher hammock still supports a mixed colony of Liguus. 55-41, Sec. 7.

Warwick Hammock, N.E. of junction Old Cutler Road (Howard Drive) and Ludlum Road. Fairly large hammock developed on deposit of Dade fine sand at eastern edge of small rockland area near glade. Possibly originally on glade edge since aerial photographs show a small arm of glade extending into edge of hammock. No definite records of Liguus. 55-40, Sec. 13.

Low hammock along north side of Cutler Creek in 55-40, Sec. 26. No definite records, but probably originally supported Liguus in some places at least.

Glade edge hammock fringe in 55-40, Sec. 11. (Not explored).

5-6. Kendal and Middle Kendal Islands - Pinelands surrounded by the glades of Cutler and Snapper Creeks. No records known.

?Low oak hammocks along glade edges may have formerly supported Liguus. No definite records.

?Hammocks on elevations in the glade of Snapper Creek north of Middle Kendal Island - several possible hammocks are known, but no definite records.

Hammock south of Upper Snapper Creek Hammock - maybe on arm of Middle Kendal Island.

7. West Kendal Island - Pinelands around Dade County Home and Hospital transected by North Kendal Drive:

County Home Hammock - area around home and hospital. Now largely cleared, but formerly fairly extensive glade-oak-tropical hardwood hammock. Contains mixed colony of Liguus, probably with some introductions. 54-40, Sec. 31.

Springhill Farm Hammock - south of Sunset Drive west of 107th Avenue. Mostly cleared. Pure colony of elliottensis. 54-40, Sec. 31.

Hammocks near north and west edge - not yet explored.

Hammocks along SW glade edge. Fragments of Liguus found by Ralph Humes, 1938.

Hammock on S. E. Glade edge - not yet explored.

?Pawpaw plantation - 5 mi. W. Kendal - loxmanicus and others. - Simpson.

7a. Hammocks on elevations in the Snapper Creek Glade east of West Kendal Island:

These hammocks in 54-40, Sec. 32 are known to have contained colonies of Liguus. Several others probably did in the past but are now largely cleared.

Chip Hammock - small hammock on elevation in glade, surrounded by fringe of cypress trees - now mostly cleared. Pure colony of elliottensis.

Large hammock south of Snapper Creek north of North Kendal Drive. Largely cleared and fenced. Mixed colony of Liguus in N.E. edge near canal - former orange grove and presently nursery.

Small hammock in NW corner of Sec. 32. Fragments of elliottensis.

8. Howard Island - Pinelands surrounded by glades of Cutler Creek:

East side of glade, oak fringe. (Pure colony of loxmanicus, found by Ralph Humes in 1938).

9. Rockdale Island - Pinelands surrounded by glades running N.W. from vicinity of Rockdale:

No records.

10. Lindgren Island - Pinelands west of Howard transected by Lindgren road:

No records.

11. Little Rockdale Island - Pinelands in glade at S. end of Rockdale Island:
?Hammock fringe along west side in 55-40, Sec. 34 - not explored.

12. Peters Island - Pinelands west of Peters-Perrine north of Black Creek glade and surrounded by arms of the glades and almost transected by an incomplete transverse glade:
No records.

13. South Cutler Island - Pinelands along Silver Bluff shoreline, south of Cutler Creek and bounded inland by the N.W. - S.W. glade connecting Black Creek and Cutler glades:
Note: This island supports an extensive hammock system which has not been thoroughly explored.
Cutler Hammock - portion south of Cutler Creek. This is the main hammock and the classic locality. Supports mixed colony of Liguus with some peculiar marmoratus-testudineus types. 55-40, Sec. 26.
?Oak-tropical hardwood hammock in 55-40, Sec. 35, along Silver Bluff shoreline south of Richmond Drive. Fragments of Liguus found by Ralph Humes, 1938.
Franjo Fringe Hammock - along glade edge from Richmond Drive to Franjo Road. No definite records. 54-40, Sec. 34 -- 56-40, Sec. 4.
Peters Hammock, east of Peters east of Franjo Road, 56-40, Sec. 4. Pure colony of lossmanicus.
Black Creek Fringe hammocks - along edge of Black Creek on South Cutler pineland edge from Franjo Road south and southeast of Old Cutler Road (Ingraham Highway). 56-40, Sec. 5-8-17. Includes 12 or more hammocks or hammock fragments. No records.
Black Creek or Black Point Hammock - developed on elevation, probably with Dane fine sand or Rockdale fine sand-limestone complex, along south side of Black Creek east of Old Cutler Road. Supports mixed colony of Liguus, including fuscoflamellus and alternatus. 56-40, Sec. 17.
Hammock developed on Perrine marl, very shallow phase, north of Black Creek in 56-40, Sec. 17. Probably never supported Liguus. Now completely cleared.
No hammocks seem to have survived along the low Silver Bluff shoreline.

14-15. Small pineland islands surrounded by glades along Quail Roost Drive:
No records. Some low oak hammock fringe shown on aerial photos.

16. Redland Island - The large incompletely dissected pinelands running from Goulds northwest into 56-39, Sec. 19, and southwest to 57-38, Sec. 5, southeast to Florida City. Goulds, Princeton, Naranja, Modello, and Homestead are built on the projecting arms of this island along the F.E.C. Railroad and U.S. Hgw. 1. The Silver Bluff shoreline is greatly dissected south of Black Creek and can be traced in only a few places. The elevation is variable, but all of the pineland seems to be above 5 feet elevation at the rock surface and some areas - northwest of Goulds - are 9 feet or more above mean sea level.
The principal extant hammocks - Cox, Ross-Costello, Timbs, Fuchs, and (actually on Longview Island) Campbell, show an interesting arrangement along a line roughly parallel to U.S. Hgw. 1 and about 2.5 mi. northwest of it and the F.E.C. Railroad. Nearly all of these hammocks are developed in the pinelands around large sinkholes. Of these only Timbs and Campbell also show a clear correlation with existing glades. Some other hammocks are clearly edge of glade hammocks such as Detroit Hammock at Florida City, probably Hattie Bauer, Lewis-Nixon and various hammock fringes. The general elevation and lack of real streams probably limited the development of hammocks except in exceptional situations. The arrangement of the principal hammocks is along a line corresponding roughly to the topographical crest of the ridge of the island although most of the incomplete transverse glades have eroded further inland

toward the Everglades. The present structure of the transverse glades between Redland and Longview Islands seems to indicate that the glades developed as drainage channels on the ridge and captured the Everglades proper as their headwaters eroded inland. The incomplete glades may have arisen as a result of water being forced under the ridge from the west and appearing aboveground on the east side of the central crest. The hammocks may lie over underground portions of glades. Such is clearly suggested by the arrangement of Cox, Ross-Costello hammocks and Caldwell, Silver Palm, and other small hammocks to the southeast of them.

The plants and *Liguus* colonies of the Redland hammocks indicate that the major hammocks (along the line indicated) are probably also the oldest. The peripheral hammocks (Lewis-Nixon, Detroit, Modello, Naranja Rockpit, and possibly others) support only pure colonies of *lossmanicus*. The central hammocks not only contain this form, but may have such peculiar mutants as "*fuscoflamellus*" (Timbs), "*castaneus*" (Cox), and others. The central hammocks are thus not only more diversified in flora but also in the composition of their tree snail colonies.

In addition to glade edge hammocks near Goulds, east of Princeton, and in the vicinity of Naranja and Modello, the following major hammocks are still intact or can be located exactly:

Cox or Hainlin Mill Hammock (now Monkey Jungle). Mixed colony. 56-39, Sec. 9.

Little Cox - a lysiloma hammock on Hainlin Mill Road at Newton Road. 56-39, Sec. 8-9. Mixed colony, probably introduced.

Ross-Costello Hammock. Mixed colony. 56-39, Secs. 16-17.

Caldwell (probably not same as hammock referred to by older workers). - A lysiloma hammock with pure colony of *lossmanicus*. 56-39, Sec. 16.

Silver Palm Hammock, on Silver Palm Road about 1.5 miles west of Goulds. A lysiloma hammock with pure colony of *lossmanicus*. Mixed snails introduced about 1942. 56-39, Sec. 15.

?Small hammock northwest of Princeton - 56-39, Sec. 22. No records.

Timbs or Timms Hammock (Bitts Hammocks 1, 2, 3, 4) - west of Tennessee Road, north of Bauer Drive. Mixed colony. 56-39, Sec. 30. (Now in county park).

Bauer Hammock, southwest of Timbs on Bauer Road just east of Krome Avenue. (Pure colony of *lossmanicus*). 56-39, Sec. 30.

Hammock or hammocks between Timbs and Bauer Hammock - 56-39, Sec. 30. Probably originally pure colonies of *lossmanicus*, but now with *Liguus* introduced from Timbs and probably other areas.

Hattie Bauer Hammock (or Murden Hammock). Originally with mixed colony of *Liguus* - 56-39, Sec. 33. (Now Orchid Jungle).

Krome Hammock, on Biscayne Drive near McMinn Road. No records. 57-39, Sec. 6.

Fuchs Hammock (or Sykes Hammock), north of Kings Highway west of Richard Road. Originally mixed colony into which other *Liguus* have been introduced. 57-38, Sec. 10.

?Redland Hammock - probably originally part of Fuchs. 57-38, Sec. 10. No records.

Lewis-Nixon Hammock - at end of Avocado Drive west of Modello. Probably originally a pure colony of *lossmanicus* into which a few *castaneozonatus* were introduced. 57-38, corner of Secs. 4-5, 8-9.

Detroit Hammock - just north of Florida City. Probably included Scott and Miller Hammocks, and possibly Cave Hammock. Remnants now in city park. Pure colony of *lossmanicus*. 57-39, Sec. 24.

?Modello Hammock, at U.S. Hgw. 1 in Modello. Location uncertain. No record.

?Modello Hammock - east of Modello in 57-39, Sec. 9, N.E. corner. Colony of elongate *lossmanicus*, K. Squires in Simpson Collection.

Naranja Rock Pit Hammock. Pure colony of lossmanicus, east of U.S. Hgw. 1 at Naranja.

?Glade edge hammocks east of Princeton. No records.

?Glade edge hammocks north of Goulds. No records.

Homestead Hammock - old record by Livingston. Probably in town of Homestead. Nature of Liguus colony unknown.

17. Longview Island - Pinelands west of Florida City separated from Redland Island by narrow transverse glade:

Campbell Hammock - on Campbell Drive E. of 212th Avenue - 57-38, Sec. 9. Mixed colony of Liguus.

Shields and Strickland hammock on glade edge west of Homestead - 57-38, Secs. 14-15. No records.

Chapman Hammock south and west of Lewis-Nixon Hammock. Mixed colony.

18. Southwest Island No. 1. - Pinelands crossed by Ingraham Highway southwest of Longview Island:

?Hammocks along glade edges - no records.

19. Southwest Island No. 2. - Pinelands east of former Royal Palm State Park on Ingraham Highway:

Oak hammocks. Several mixed colonies not exactly located.

Hammock 1 mi. east of Royal Palm State Park lodge - 58-37, Sec. 14. Mixed colony with eburneus.

I wish to acknowledge the assistance of Mr. Ralph Humes of Miami and Mr. Fred Fuchs, Sr. of Homestead for information concerning the older localities. Descriptions of some of the hammocks are to be found in the botanical works of John K. Small in the Journal of New York Botanical Gardens.

I would appreciate additions, corrections, or emendations to the preceding list as well as information concerning material available for study in museums or private collections.

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