

Biogeography and hosts of poroid wood decay fungi in North Carolina: species of *Phellinus* and *Schizopora*

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ABSTRACT: Distribution and host plants in North Carolina are given for 21 species of *Phellinus* and three species of *Schizopora*. A county distribution map is provided for each species. *Phellinus johnsonianus*, *P. linteus* and *P. melleoporus* and *Schizopora flavipora* are reported for the first time in North Carolina. Numerous new fungus-host plant associations are reported. Species checklists and figures can be accessed at:

http://www.cals.ncsu.edu/plantpath/Personnel/Faculty/Grand/mycotaxon_1.html

Keywords: fungus distribution, polypores.

INTRODUCTION

The importance of fungal biodiversity in ecosystems is well-documented (Lodge 1996, Molina et al. 2001, Rossman & Farr 1997). Recent studies have emphasized fungal biodiversity in unique ecosystems and within unique geographical areas (Esqueda *et al.* 2003, Gilbertoni & Calvacanti 2003, Keller & Skrabal 2002, Mueller & Mata, 2001, Riccardi & Bashore 2003, Rossman *et al.* 1998). Such studies provide a basic foundation of data that can aid future researchers in knowing what species of fungi are present as well as their distribution within defined areas.

The diversity of ecosystems in North Carolina is reflected by its diversity of flora (Kartesz 1999, Pittillo et al. 1998, Radford et al. 1968). The diversity of woody plant species allows for an equally diverse and large number of poroid wood-decay fungi.

Previous studies (Grand & Vernia 2002, Grand & Vernia 2003, Jung 1987, Vernia & Grand 2000) have reported species of fungi, chiefly poroid wood decay species, from a variety of sites in North Carolina. These studies (Grand & Vernia 2002, Vernia & Grand 2000) addressed new geographical occurrences and new host-plant combinations in North Carolina and the United States and emphasized the need for providing host and distributional data for this important group of fungi.

Distributions of *Phellinus* and *Schizopora* in the Southeast by state were reported by Farr *et al.* 1989, Grand *et al.* 1976, Gilbertson & Ryvarden 1987, Larsen &

Cobb-Pouille 1990, Lowe 1966, Lowe & Gilbertson 1961, and Overholts 1953.

This is the first of a series of papers that provides data on species, host plants and distribution of poroid wood decay fungi in North Carolina.

MATERIALS AND METHODS

Intensive collecting was done in North Carolina over the past six years (1997-2003). Additional collections in the Mycological Herbarium, Department of Plant Pathology, North Carolina State University (NCU) were examined and records of the Plant Disease and Insect Clinic, Department of Plant Pathology, NCSU were utilized in the results. Previous studies (Grand *et al.* 1975, Jung 1987) that contained information on specific county locations of poroid wood-decay species were used in developing the distribution maps. Likewise, data from the BPI website (Farr *et al.* n.d.) provided some county data.

Collections were made of all uncommon species of *Phellinus* and *Schizopora*, unusual forms of these species and species occurring on new or unusual hosts. Specimens were placed in paper bags in the field usually with a sample of decayed wood and appropriate field notes. Specimens were examined in the laboratory and identified using existing taxonomic treatments (Breitenbach & Kraenzlin 1986, Gilbertson & Ryvarden 1986, 1987, Jung 1987, Larsen & Cobb-Pouille 1990, Lowe 1966, Lowe & Gilbertson 1961, Overholts 1953). Collections of *Schizopora apacheriensis* (Gilb. & Canf.) Gilb. & Ryvarden and *S. flavipora* (Cooke) Ryvarden were compared to type specimens (BPI #0237818 and #0239985). Nomenclature and authorities are from Gilbertson & Ryvarden (1986, 1987) and Kirk & Ansell (1992) for the fungi and Kartesz and Kartesz (1980) for the host plant species.

The majority of collection sites were in state parks, game lands and natural areas, Nantahala, Pisgah, Croatan and Uwharrie National Forests, the Blue Ridge Parkway and the Great Smoky Mountains National Park. Counties collected in are shown in Fig. 1. A county distribution map is provided for each species (Figs. 2-25).

RESULTS AND DISCUSSION

Twenty-one species of *Phellinus* were found on 56 host species. *Phellinus gilvus* (Schwein.:Fr.) Pat. is the most wide-spread species with *P. gilvus* and *P. contiguus* (Fr.) Pat. reported on the greatest number of host species. *Phellinus johnsonianus* (Murrill) Ryvarden, *P. linteus* (Berk. & M.A. Curtis) Teng and *P. melleoporus* (Murrill) Ryvarden are reported for the first time in North Carolina. All three of these species were previously reported from the Gulf Coast region with *P. johnsonianus* ranging into northeastern United States through the Mississippi River Valley.

All three species of *Schizopora* reported in the United States (Gilbertson & Ryvarden 1987) were found on 41 host species. *Schizopora paradoxa* (Fr.) Donk was the most widespread and most frequently encountered species of *Schizopora*. *Schizopora flavipora* is reported for the first time in North Carolina. *Schizopora apacheriensis* is reported on 20 host species which represents a substantial increase from the 11 hosts reported by Farr *et al.* (1989). *Schizopora apacheriensis* was only recently reported in North Carolina for the first time on *Carpinus caroliniana* Walt. (Grand & Vernia 2002). This study substantially increases the geographic and host

species ranges of *S. apacheriensis*. Gilbertson & Ryvarden (1987) indicated this species occurs in Arizona and the Gulf Coast region and contend that it has often been confused with *S. paradoxa*. Likewise, the relatively widespread occurrence of *S. flavipora* in North Carolina (Fig. 24) substantiates the statement by Gilbertson & Ryvarden (1987) that *S. flavipora* also is often confused with *S. paradoxa* and that the geographical range of *S. flavipora* is unclear.

Checklists for the species and maps of the species distributions within North Carolina can be found at:
http://www.cals.ncsu.edu/plantpath/Personnel/Faculty/Grand/mycotaxon_1.pdf

LIST OF SPECIES

Species of fungi reported for the first time in North Carolina are indicated by an asterisk and new fungus-host associations for the United States are indicated by a double asterisk. Counties are in parenthesis following host species.

***Phellinus chrysoloma* (Fr.) Donk (Fig. 2)**

Substrate: *Picea rubens* Sarg. (Haywood, Mitchell, Swain, Transylvania); ***Pinus virginiana* Mill. (Gaston); *Pinus* sp. (Wake); ***Tsuga canadensis* (L.) Carr (Ashe); unidentified substrate (Avery, Yancey, Jung, 1987).

***Phellinus conchatus* (Pers.:Fr.) Quel. (Fig. 3)**

Substrate: *Liquidambar styraciflua* L. (Wake); ***Quercus alba* L. (Durham); unidentified substrate (Buncombe, Henderson).

***Phellinus contiguus* (Fig. 4)**

Substrate: *Acer barbatum* Michx. (Macon); *A. pensylvanicum* L. (Haywood, Macon); *A. rubrum* L. (Durham); *Betula lenta* L. (Ashe, Swain, Watauga); *Carpinus caroliniana* (Haywood); *Carya* sp. (Franklin); *Fagus grandifolia* Ehrh. (Macon); *Nyssa sylvatica* Marsh. (Swain); *Prunus pensylvanica* L. (Haywood, Swain); *P. serotina* Ehrh. (Swain); *Rhododendron catawbiense* Michx. (Mitchell); *Vitis baileyana* Munson (Durham); *Vitis rotundifolia* Michx. (Wake).

***Phellinus everhartii* (Ellis & Gall) A. Ames (Fig. 5)**

Substrate: *Betula alleghaniensis* Brit. (Jackson); *Quercus alba* (Wake); *Q. coccinea* Muench. (Burke, Transylvania); *Q. falcata* Michx. (Montgomery, Rowan, Wake); ***Q. laevis* Walt. (Richmond); *Q. nigra* L. (Wake); *Q. phellos* L. [Durham (Rosenthal, 1963), Johnston]; ***Q. rubra* L. (Macon, Transylvania); *Q. stellata* Wang. (Durham, Wolf, 1938); *Q. velutina* Lam. [Durham (Wolf, et al., 1938), Stokes]; ***Q. virginiana* Mill. (Dare); unidentified substrate (Buncombe, Henderson).

***Phellinus ferreus* (Pers.) Bourdot & Galzin (Fig. 6)**

Substrate: *Amelanchier arborea* (Michx.) Fernald (Jackson); *Quercus virginiana* (Pender); unidentified substrate [Haywood, Swain (Jung, 1987)].

***Phellinus ferrugineo-velutinus* (Henn.) Ryvarden (Fig. 7)**

Substrate: *Liriodendron tulipifera* L. (Randolph); *Quercus rubra* (Watauga); ***Vitis rotundifolia* Michx. (Wake).

***Phellinus ferruginosus* (Schräd.: Fr.) Bourdot (Fig. 8)**

Substrate: ***Pinus virginiana* (Gaston, Jackson); *Pinus* sp. [Durham (Wolf, et al., 1938)]; ***Rhododendron catawbiense* (Macon); unidentified substrate [Haywood, Swain (Jung, 1987)].

***Phellinus gilvus* (Fig. 9)**

Substrate: *Acer rubrum* (Chatham, Cherokee, Columbus, Currituck, Dare, Gates, Haywood, Hyde, Swain); *Amelanchier arborea* (Ashe); *Betula alleghaniensis* (Ashe, Mitchell, Swain, Yancey); *B. lenta* (Buncombe, Macon, Swain); *B. nigra* L. (Durham, Wake); *Carpinus caroliniana* (Durham, Macon, Montgomery, Rowan, Wake); *Carya alba* K. Koch (Wake); *C. cordiformis* (Wang.) K. Koch (Durham, Wake); *Carya glabra* (P. Mill.) Sweet (Dare, Durham, Swain, Transylvania); *Carya pallida* (Ashe) Engler & Graebner (Wayne); *Carya* sp. (Swain, Wake); *Chamaecyparis thyoides* (L.) BSP (Dare); *Cornus florida* L. (Alamance); *Fagus grandifolia* (Haywood); *Fraxinus americana* L. (Durham, Gates); *Gleditsia triacanthos* L. (Montgomery); *Juglans cinerea* L. (Ashe); *J. nigra* L. (Jones, Robeson, Wake); *Kalmia latifolia* L. (Avery, Transylvania); *Liquidambar styraciflua* (Beaufort, Bladen, Camden, Craven, Currituck, Gates, Granville, Jones, Montgomery, Pender); *Liriodendron tulipifera* (Vance, Wake); *Magnolia virginiana* L. (Craven); *Nyssa aquatica* Marsh. (Dare); *Oxydendrum arboreum* (L.) DC (Granville, Randolph, Wake); *Persea borbonia* (L.) Spreng. (Dare, Hyde); *Populus* sp. (Lenoir); *Quercus alba* (Chatham, Franklin, Halifax, Swain, Transylvania, Wake); *Q. coccinea* (McDowell); ***Q. falcata* (Johnston, Stokes); ***Q. laurifolia* Michx. (Robeson); ***Q. lyrata* Walt. (Wayne); *Q. nigra* (Anson, Bladen, Craven); ***Q. phellos* (Montgomery); *Q. prinus* (Surry); *Q. rubra* (Buncombe, Chatham, Durham, Granville, Jones, Stanly, Surry, Vance, Watauga, Wayne); *Q. virginiana* (Currituck, Dare, New Hanover, Pender); *Q. sp.* (Ashe, Burke, Cherokee, Gates, Graham, Johnston, Macon, Person); *Salix nigra* Marsh. (Currituck); unidentified substrate (Buncombe, Graham, Henderson).

***Phellinus igniarius* (L.:Fr.) Quel. (Fig. 10)**

Substrate: *Acer rubrum* (Watauga); *Betula alleghaniensis* (Swain, Watauga, Yancey); *B. lenta* (Haywood, Watauga); *Carya* sp. (Pender); *Quercus* sp. [Durham (Wolf, et al., 1938)]; unidentified substrate [Avery (Jung, 1987), Henderson, McDowell].

*** *Phellinus johnsonianus* (Fig. 11)**

Substrate: ***Acer rubrum* (Wake).

***Phellinus laevigatus* (Fr.) Bourdot & Galzin (Fig. 12)**

Substrate: *Betula alleghaniensis* (Avery, Burke, Haywood, Swain, Transylvania, Watauga, Yancey); *B. lenta* (Avery, Graham, Macon, Swain, Watauga); *B. nigra* (Durham, Granville, Halifax, Wake); *Photina x fraseri* Dress. (Wake); *Quercus virginiana* (Beaufort, Dare, Onslow); *Rhododendron maximum* L. (Madison, Watauga); unidentified substrate [Caldwell, Jackson (Jung, 1987), McDowell].

*** *Phellinus linteus* (Fig. 13)**

Substrate: ***Persea borbonia* (Dare).

*** *Phellinus melleoporus* (Fig. 14)**

Substrate: ***Acer rubrum* (Stokes).

***Phellinus pini* (Thore:Fr.) A. Ames (Fig. 15)**

Substrate: *Abies fraseri* (Pursh.) Poir [Avery (Cordell and Astin, 1965), Watauga]; *Pinus strobus* L. (Avery, Chatham, Transylvania, Wilkes); *P. taeda* L. (Beaufort, Hyde, Jones, Stokes, Wake); *P. virginiana* (Graham, Surry); *P. sp.* [Durham, (Wolf, et al., 1938)]; unidentified substrate (Henderson).

***Phellinus pomaceus* (Pers.:Gray) Maire (Fig. 16)**

Substrate: *Malus* sp. [Durham (Wolf, et al., 1938)]; *Prunus pensylvanica* (Haywood).

***Phellinus punctatus* (Fr.) Pilat (Fig. 17)**

Substrate: ***Acer rubrum* (Wake); *Carpinus caroliniana* (Granville); *Elaeagnus umbellata* Thunb. (Chatham); *Fraxinus* sp. (Pender); *Prunus serotina* (Orange); ***Quercus virginiana* (New Hanover, Pender); *Q. sp.* (Wake).

***Phellinus robiniae* (Murrill) A. Ames (Fig. 18)**

Substrate: *Robinia pseudoacacia* L. (Alleghany, Anson, Ashe, Buncombe, Burke, Caldwell, Clay, Davidson, Graham, Henderson, Iredell, Jackson, Macon, Madison, McDowell, Mitchell, Polk, Rutherford, Stokes, Surry, Swain, Transylvania, Union, Wake, Watauga, Wilkes, Yancey); ***Robinia viscosa* Vent. (Macon).

***Phellinus robustus* (P. Karst.) Bourdot & Galzin (Fig. 19)**

Substrate: *Betula nigra* (Durham, Wake); *Fagus grandifolia* [Haywood (Jung, 1987)]; ***Quercus alba* (Catawba); *Q. nigra* (Halifax, Pender); *Q. rubra* (Wayne); *Q. sp.* (Catawba); unidentified substrate (Henderson).

***Phellinus spiculosus* (W.A. Campb. & R.W. Davidson) Niemala (Fig. 20)**

Substrate: ***Betula alleghaniensis* (Surry, Mitchell); *Carya glabra* [Buncombe (Lombard & Larsen, 1985), Durham]; ***Cornus florida* (Surry); ***Quercus coccinea* (Halifax, Wake); *Q. nigra* (Halifax, Wake); ***Q. rubra* (Halifax, Johnston, Wake); *Quercus* sp. (Johnston).

***Phellinus viticola* (Schwein.:Fr.) Donk (Fig. 21)**

Substrate: *Betula alleghaniensis* [Avery (Jung, 1987)]; ***Pinus virginiana* (Wake, Wayne).

***Phellinus wahlbergii* (Fr.) D.A. Reid (Fig. 22)**

Substrate: *Fagus grandifolia* (Haywood).

***Schizopora apacheriensis* (Fig. 23)**

Substrate: ***Acer rubrum* (Alleghany, Dare, Johnston, Watauga); ***Betula lenta* (Swain); ***Carpinus caroliniana* (Dare, Durham, Halifax, Polk, Rutherford, Wake); ***Fagus grandifolia* (Halifax); ***Fraxinus americana* (Buncombe); ***Liriodendron tulipifera* (Vance, Wake); ***Oxydendrum arboreum* (Orange, Wake); ***Persea borbonia* (Currituck); ***Pinus echinata* P. Mill. (Wake); *Pinus* sp. (Durham); ***P. taeda* (Dare, Hyde, Wayne); ***P. virginiana* (Wake); *Prunus* sp. (New Hanover, Wake); ***Quercus alba* (Johnston, Wake, Wayne); ***Q. coccinea* (Gaston, Wake); ***Q. falcata* (Johnston); ***Q. lyrata* (Wayne); ***Q. phellos* (Wake); ***Q. prinus* L. (Orange, Surry); ***Q. rubra* (Wake); ***Q. virginiana* (Dare); *Q. spp.* (Durham, Macon, Watauga, Wilkes); ***Rhododendron maximum* (Watauga); ***Tsuga canadensis* (Graham); ***Vitis* spp. (Polk, Wake).

***Schizopora flavipora* (Fig. 24)**

Substrate: ***Acer rubrum* (Camden); ***Betula lenta* (Burke); ***Pinus echinata* (Wake); ***P. taeda* (Hyde); ***Q. alba* (Orange); ***Q. prinus* (Stanly); ***Q. rubra* (Durham); *Q. spp.* (Mitchell, Wake).

***Schizopora paradoxa* (Fig. 25)**

Substrate: *Acer rubrum* (Avery, Chatham, Durham, Gates, Harnett, Hyde, Swain, Transylvania, Wake); *Betula alleghaniensis* (Swain); *B. lenta* (Graham, Polk); *B. nigra* (Durham, Richmond, Robeson, Vance, Wake); *Carpinus caroliniana* (Haywood, Wake, Wayne); *Carya glabra* (Dare, Montgomery, Transylvania); *Carya* sp. (Buncombe, Craven, Rowan, Swain, Wake); *Castanea dentata* (Marsh.) Borkh. (Buncombe); *Cornus florida* (Montgomery); *Fagus grandifolia* (Durham); *Fraxinus caroliniana* P. Mill. (Camden); *Gleditsia triacanthos* (Montgomery); *Ilex opaca* Ait. (Durham, Stanly); *I. vomitoria* Ait. (Hyde); *Juglans nigra* (Wake); *Juniperus*

virginiana l. (Wake); *Kalmia latifolia* (Chatham); *Liquidambar styraciflua* (Durham, Gates, Jones, Martin, Montgomery, Tyrell); *Liriodendron tulipifera* (Ashe, Durham, Franklin, Wake); *Magnolia tripetala* L. (Wake); *Morus rubra* L. (Montgomery); *Oxydendrum arboreum* (Durham, Franklin, Orange, Randolph, Wake); *Persea borbonia* (New Hanover); *Photinia x fraseri* (Wake); *Pinus taeda* (Dare, Granville, Nash, Wake); *P. virginiana* (Anson); *Prunus pensylvanica* (Mitchell); *P. serotina* (Chatham, Wake); *Quercus alba* (Anson, Chatham, Craven, Durham, Franklin, Montgomery, Transylvania, Vance, Wake, Wayne); *Q. coccinea* (Burke, Transylvania); *Q. falcata* (Johnston, Orange, Wake); *Q. hemisphaerica* Bartr. (Dare); *Q. incana* Bartr. (Richmond); *Q. laurifolia* (Robeson); *Q. laevis* Walt. (Richmond); *Q. marilandica* Muench. (Orange); *Q. nigra* (Beaufort, Craven, Dare, Northampton, Pender, Wake); *Q. phellos* (Granville, Montgomery, Warren); *Q. prinus* (Harnett, Stokes, Wake); *Q. rubra* (Ashe, Clay, Durham, Granville, Harnett, Macon, Montgomery, Moore, Orange, Swain, Vance, Wake, Wayne); *Q. stellata* (Clay, Franklin); *Q. velutina* (Vance, Wake); *Q. virginiana* (New Hanover); *Q. spp.* (Columbus, Franklin, Macon, Montgomery, Orange, Wilkes); *Rhododendron catawbiense* (Macon); *R. maximum* (Macon); *Salix nigra* (Gates); *Vitis spp.* (Buncombe, Wake).

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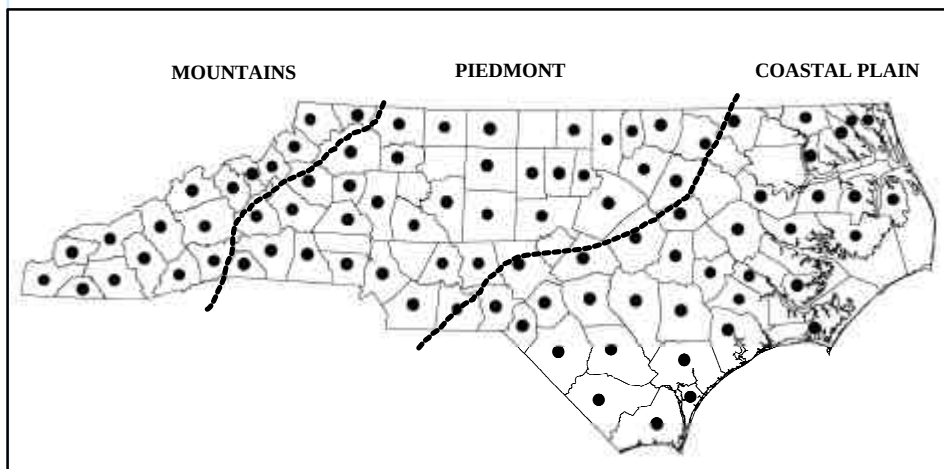


Fig. 1. Map of North Carolina indicating counties visited during 1997-2003 collecting period (dots) with physiographic provinces superimposed (lines)

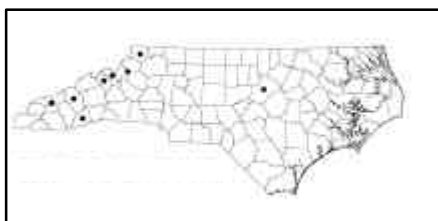


Fig. 2. Distribution of *Phellinus chrysoloma* in North Carolina



Fig. 3. Distribution of *P. conchatus* in North Carolina

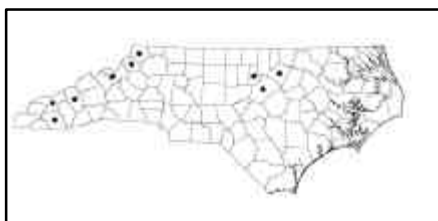


Fig. 4. Distribution of *P. contiguus* in North Carolina

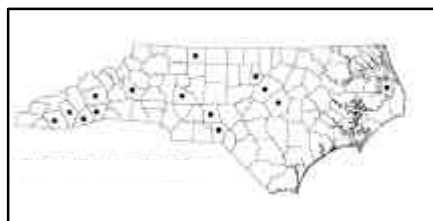


Fig. 5. Distribution of *P. everhartii* in North Carolina

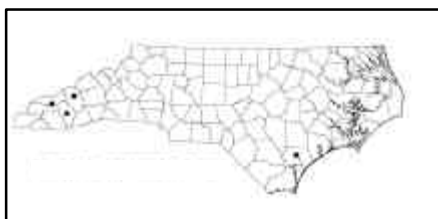


Fig. 6. Distribution of *P. ferreus* in North Carolina

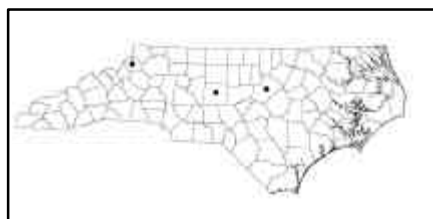


Fig. 7. Distribution of *P. ferrugineo-velutinus* in North Carolina



Fig. 8. Distribution of *P. ferruginosus* in North Carolina

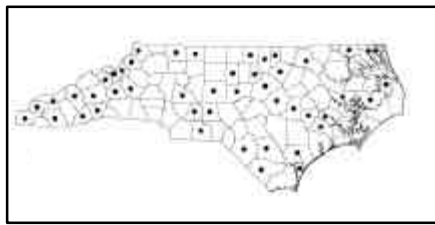


Fig. 9. Distribution of *P. gilvus* in North Carolina



Fig. 10. Distribution of *P. igniarius* in North Carolina



Fig. 11. Distribution of *P. johnsonianus* in North Carolina

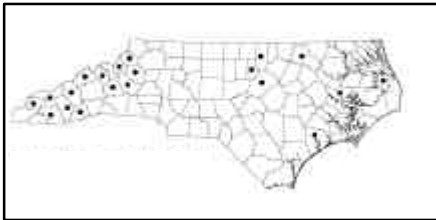


Fig. 12. Distribution of *P. laevigatus* in North Carolina



Fig. 13. Distribution of *P. linteus* in North Carolina

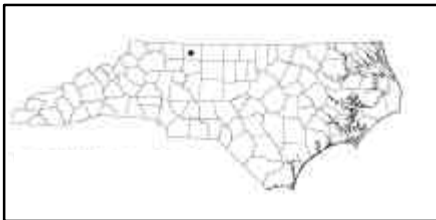


Fig. 14. Distribution of *P. melleoporus* in North Carolina

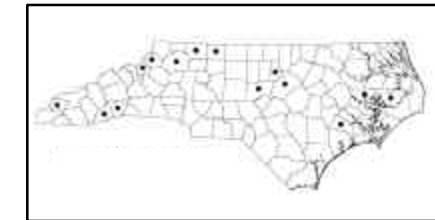


Fig. 15. Distribution of *P. pini* in North Carolina

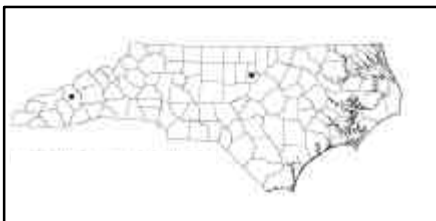


Fig. 16. Distribution of *P. pomaceus* in North Carolina



Fig. 17. Distribution of *P. punctatus* in North Carolina

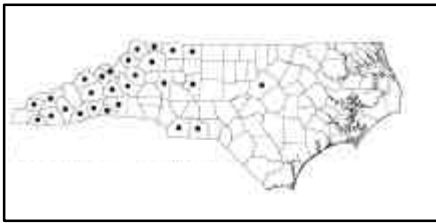


Fig. 18. Distribution of *P. robiniae* in North Carolina



Fig. 19. Distribution of *P. robustus* in North Carolina

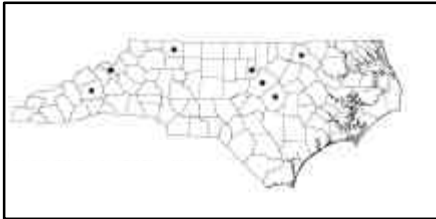


Fig. 20. Distribution of *P. spiculosus* in North Carolina



Fig. 21. Distribution of *P. viticola* in North Carolina



Fig. 22. Distribution of *P. wahlbergii* in North Carolina

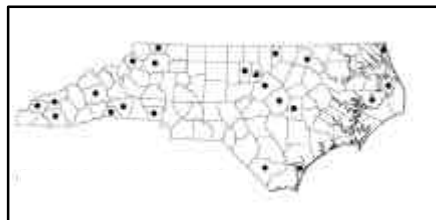


Fig. 23. Distribution of *Schizopora apacheriensis* in North Carolina

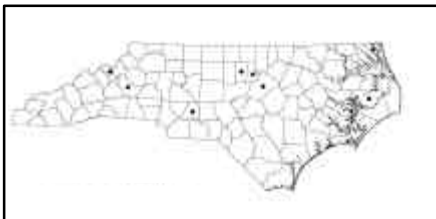


Fig. 24. Distribution of *S. flavipora* in North Carolina

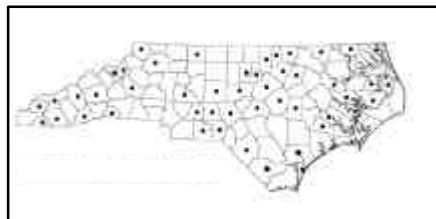


Fig. 25. Distribution of *S. paradoxa* in North Carolina