出國報告(出國類別：其它)

赴美國執行氣候變遷下植物疫災防控措施交流

服務機關：行政院農業委員會動植物防疫檢疫局

單位、姓名職稱：

植物防疫組：陳子偉組長、歐陽瑋科長

動物防疫組：姚中慧簡任技正

植物檢疫組：周俊男技正

派赴國家：美國

出國期間：**111** 年 **11** 月 **12** 日~**11** 月 **21** 日

報告日期：**112** 年 **2** 月 **6** 日

出國報告審核表

出國報告名稱：赴美國執行氣候變遷下植物疫災防控措施交流			
出國人姓名 （2人以上，以1人為代表）	職稱	服務單位	
周俊男	技正	行政院農業委員會動植物防疫檢疫局	
出國類別	□考察 □進修 □研究 □實習 □視察 □訪問 □開會 □談判 ■其他＿＿＿＿＿＿＿＿ (出國類別請依預算書之計畫預算類別填列)		
出國期間：111年11月12日至111年11月21日		報告繳交日期：112年 2 月 6 日	

出國人員自我檢核	計畫主辦機關審核	審　核　項　目
■	■	1.依限繳交出國報告
■	■	2.格式完整（本文必須具備「目的」、「過程」、「心得及建議事項」）
■	■	3.無抄襲相關資料
■	■	4.內容充實完備
■	■	5.建議具參考價值
■	■	6.送本機關參考或研辦
□	□	7.送上級機關參考
□	□	8.退回補正，原因：
□	□	（1）不符原核定出國計畫
□	□	（2）以外文撰寫或僅以所蒐集外文資料為內容
□	□	（3）內容空洞簡略或未涵蓋規定要項
□	□	（4）抄襲相關資料之全部或部分內容
□	□	（5）引用相關資料未註明資料來源
□	□	（6）電子檔案未依格式辦理
■	■	9.本報告除上傳至出國報告資訊網外，將採行之公開發表：
■	■	（1）辦理本機關出國報告座談會（說明會），與同仁進行知識分享。
☑	☑	（2）於本機關業務會報提出報告
□	□	（3）其他＿＿＿＿＿＿＿＿
□	□	10.其他處理意見及方式：

出國人簽章（2人以上，得以1人為代表）	計畫主辦機關審核人	一級單位主管簽章	機關首長或其授權人員簽章
周俊男		[illegible]	[illegible]

說明：

一、各機關可依需要自行增列審核項目內容，出國報告審核完畢本表請自行保存。

二、審核作業應儘速完成，以不影響出國人員上傳出國報告至「公務出國報告資訊網」為原則。

摘　要

為瞭解美國於氣候變遷下，對於植物疫災防控措施最新進展及實務作業，行政院農業委員會動植物防疫檢疫局於111年11月12日至21日由植物防疫組陳子偉組長率該組歐陽瑋科長、動物防疫組姚中慧簡任技正及植物檢疫組周俊男技正一行前往美國，瞭解美國動植物檢疫署(Animal and Plant Health Inspection Service，APHIS)因應氣候變遷調適計畫與相關作為、美國生物防治體管理、入侵果實蠅緊急防治計畫及該署緊急防控中心，以及北卡羅萊納州立大學作物有害生物綜合管理中心(NCSU Center for Integrative Pest Management)、空間地理分析中心(Center for Geospatial Analytics)及植物病蟲害診所(Plant Disease and Insect Clinic，PDIC)，與美方專家進行充分實務作業交流與心得分享。

目　次

壹、前言與目的

氣候變遷為近年國際新興議題，因全球氣候運作模式改變，造成部分地區降雨與蒸發散的強度升高或更乾旱，且地球持續升溫已對全球生物生態系造成影響。為瞭解美國於氣候變遷下，針對植物疫災防控措施最新進展及實務作業，行政院農業委員會動植物防疫檢疫局於111年11月12日至21日由植物防疫組陳子偉組長率該組歐陽瑋科長、動物防疫組姚中慧簡任技正及植物檢疫組周俊男技正一行前往美國交流。並由美國農業部(USDA)動植物檢疫署(Animal and Plant Health Inspection Service，APHIS)依我方需求安排相關參訪及研習課程。本次行程瞭解美方因應氣候變遷調適計畫與相關作為、美國生物防治體管理、入侵果實蠅緊急防治計畫並參訪該署緊急防控中心，以及北卡羅萊納州立大學作物有害生物綜合管理中心(NCSU Center for Integrative Pest Management)、空間地理分析中心(Center for Geospatial Analytics)及植物病蟲害診所(Plant Disease and Insect Clinic，PDIC)，與美方專家進行充分實務作業交流與心得分享。

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貳、行程及工作紀要

日期	地點	工作內容
11/12-13	臺北─桃園─洛杉磯─華盛頓特區	11/12 23:55 搭乘長榮航空 BR16 班機，於美國時間晚間 19:25 抵達洛杉磯國際機場。23:40 搭乘美國航空 UA1394 班機，於 11/13 07:29 抵達華盛頓杜勒斯機場。
11/14	華盛頓特區	1. 上午 10 時由駐美代表處農業組林麗芳組長及裘君耀副組長陪同，抵達美國動植物檢疫署總部，由美方介紹本次研習及參訪行程，美方與會人員名單如下： (1) Mr. Ibrahim Shaqir; Associate Deputy Administrator, International Phytosanitary Issues Management and Standards Program; USDA-APHIS-PPQ (2) Ms. Jennifer Jones; Director, Phytosanitary Issues Management, USDA-APHIS-PPQ (3) Dr. Matt Messenger; Deputy Director, Asia and the Pacific Islands; Phytosanitary Issues Management, USDA-APHIS-PPQ (4) Dr. Amanda Kenney; Trade Director for Australia, New Zealand, the Pacific Islands, and Taiwan; Phytosanitary Issues Management, USDA-APHIS-PPQ (5) Dr. Natalie Howe; International Technical and Regulatory Capacity Building; Phytosanitary Issues Management, USDA-APHIS-PPQ (6) Mr. Ricardo Valez; International Services, USDA-APHIS 2. 本日由相關專家就下列主題進行簡報及雙方交流： (1) 由 Ms. Hon. Hilda Diaz-Soltero (Climate Change Adaptation Lead for APHIS)介紹 APHIS 於 2022 至 2025 年氣候變遷調適計畫之規劃與執行 (2) 由 Dr. Glenn Fowler (USDA-APHIS-PPQ, Risk

		Analyst)介紹植物健康與氣候變遷 (3) 由 Ms. Stephanie Dubon (NAPPO Technical Director, USDA-APHIS-PPQ)介紹北美植物保護組織於氣候變遷下之相關策略計畫 (4) 由 Ms. Michon Oubichon (Deputy Administrator, Emergency & Regulatory Compliance Services, USDA-APHIS)介紹 APHIS 於動植物疫病協同合作及緊急反應措施。 (5) 由 Mr. Justin Salus (Emergency Management Branch Chief, USDA APHIS-ERCS -)介紹 APHIS 緊急防控中心(Emergency Operation Center) (6) 由 Ms. Kimberly Pfirrmann-Powell (Emergency Coordination Branch Chief, USDA-APHIS-ERCS)介紹美國 USDA、APHIS 與聯邦緊急事務管理署(FEMA)於緊急反應措施之合作。
11/15	華盛頓特區-北卡羅萊納州 羅利市(Raleigh, North Carolina)	17:19 搭乘聯合航空 UA592 班機，晚間 18:50 抵達羅理德罕機場。住宿羅利市。
11/16	北卡羅萊納州羅利市(Raleigh, North Carolina)	一、 前往北卡羅萊納州立大學 Centennial 校區之 APHIS 辦公室進行參訪。 二、 由 Dr. Ron Weeks (National Science Program Coordinator, USDA-APHIS-PPQ)、Mr. Keith Colpetzer (National Operations Manager, USDA-APHIS-PPQ)及 Dr. Robert Pfannenstiel (Biological Control Specialist, USDA-APHIS-PPQ)介紹美國生物防治體之管理及應用。 三、 由 Ms. Tara Holtz (Director of Domestic and Emergency Scientific Support, USDA-APHIS-PPQ)介紹美國入侵果實蠅緊急防治。
11/17	北卡羅萊納州羅利市(Raleigh, North Carolina)	一、 上午前往北卡羅萊納州立大學 Centennial 校區之 APHIS 辦公室進行參訪。 二、 由北卡羅來納州立大學作物有害生物綜合管理中心研究學者 Dr. Yu Takeuchi 、Mr. Kevin Bigsby

		(Assistant Director, USDA-APHIS-PPQ)及分析師 Dr. Amber Tripodi (USDA-APHIS-PPQ, Risk Analyst)介紹空間分析高級風險信息系統(SAFARIS. Spatial Analytic Framework for Advanced Risk Information Systems)應用於氣候變遷對於有害生物之影響 三、 下午前往北卡羅來納州立大學空間地理分析中心由 Dr. Chris Jones 介紹有害生物時空分布模型及 WebGIS 及 Tangible 等輔助決策系統。
11/18	北卡羅萊納州羅利市(Raleigh, North Carolina)	前往北卡羅萊納州立大學植物病蟲害診所，由主任 Dr. Matt Bertone 及植病專家 Mr. Mike Munster 介紹北卡羅萊納州立大學植物病蟲害診所協助民眾診斷植物有害生物流程
11/19-21	洛杉磯─桃園─臺北	11/19 17:10 搭乘達美航空 DL763 班機於當日 19:44 抵達洛杉磯國際機場，於 23:30 搭乘長榮 BR15 班機，於臺北時間 11/21 日 6:05 抵達桃園中正國際機場。

參、交流與參訪結果

一、 美國動植物防疫檢疫署因應氣候變遷調適計畫(APHIS Climate Change Adaptation Plan)

美國農業部(USDA動植物防疫檢疫署(APHIS)扣合美國農業部之因應氣候變遷調適計畫制定前揭計畫(附件1)，該計畫包含關切因應氣候變遷所導致農業生產力下降(Impacts to agricultural productivity)、極端氣候所導致之相關衝擊(Shocks Due to Extreme Climate Events)、環境正義(Environmental Justice)、氣候變遷素養(Climate Literacy)等議題。

在因應氣候變遷所導致農業生產力下降議題相關作為包括：開發野生動物中新興人畜共通傳染病進行採樣程序與方法、建置氣候適應圖資，預測地區之有害生物適應性變化、識別、監測並防止動植物有害生物傳入、監測並加速授粉媒介相關健康工作、研發溴化甲烷替代工具、持續外來入侵物種之生物防治製劑研究、實施鼓勵木材及木製品合法交易之貿易政策、持續與世界動物衛生組織(OIE)、國際植物保護公約(IPPC)及貿易夥伴就氣候變遷相關措施展開合作、基因工程植物移動和釋放之政策研究及支持研發因應氣候變遷之作物品種研發。

在極端氣候所導致之相關衝擊議題之作為包括：確保極端氣候事件發生時相關機構可持續營運，預備因應措施以協助生產者。制定大規模動物死亡時運輸和處置計畫，強化糧食分配之能力、建置網頁協助執行相關緊急應變計畫。

有關環境正義議題相關作為包括：跨領域適應問題，包括確定應變量能不足的社區及其缺口，協助前揭社區獲得更多氣候變遷適應的相關投資機會、提高勞動人力瞭解因應相關氣候變遷適應議題認知。

有關氣候變遷素養包括：確認現有及開發有關氣候變遷之訓練計畫，並與美國農業部氣候中心協調及研擬相關合作計畫。

前揭計畫期程為2022年4月起至2025年，期間將滾動式調整相關作為。APHIS

並針對前揭議題進行分工、確認外部合作單位及建立評估指標以確保相關行動計畫可順利進行。

二、 國際植物保護公約(IPPC)及北美植物保護組織(NAPPO)氣候變遷議題相關計畫

IPPC及NAPPO皆指出氣候變遷將對生物多樣性和環境產生威脅，除農業生產外，入侵有害生物亦對野生植物、森林和整個生態系統構成威脅。前揭威脅將因氣候變遷而加劇，氣候變遷預計將導致害蟲分佈的地理範圍擴大、更頻繁地引入害蟲、害蟲爆發模式發生變化，如前往新的或擴大的威脅地區，對於種植新品種作物，亦可能會導致目前未知的有害生物風險。面對該威脅，各國應透過有害生物監測之國際合作，使各國於發生新有害生物時得相互溝通，及時獲得情報。另一方式則進行有害生物的分佈模式預測，如空間分析高級風險信息系統 (Spatial Analytic Framework for Advanced Risk Information Systems，SAFARIS)，可更有效預測有害生物之遷徙，提供預警，以減少氣候變遷之相關威脅，相關內容詳如附件2。

三、 美國農業部與動植物防疫檢疫署於緊急疫災扮演之角色

美國聯邦緊急事務管理署(The Federal Emergency Management Agency，FEMA)綜領全國或地區性重大疫災(包括颶風、林地野火、洪水、地震、海嘯、流感)之應變，建立疫災應變支持功能(Emergency Support Functions，ESF)，規劃分工架構提供跨部會協調，其中美國農業部主要負責ESF#11，執行於農業重大疫病與有害生物發生時，確保國家食物供應、保護自然及農業資源。**E**SF#11依據地理區將全國分為11區，並依據農業部內之專業進行分工，APHIS負責部分包含動植物疾病與有害生物之應變與家庭寵物之安全等。無疫災發生時，ESF#11進行教育訓練、維持各部門聯繫及各種整備等工作，一旦於疫災發生時，則負責USDA與FEMA之聯繫及擔任溝通、回報等工作。

APHIS內部之緊急防控中心稱為Dr. Jere L. Dick Operations Center (JDOC)，負

責資訊收集、分析、溝通協調，並將資訊彙報予署內首長，防控中心設備係因應重大疫災彙報所需建置，包含大型液晶電視便於簡報及資訊展示、不斷電系統、衛星電話、衛星電視、影印機等。主要會議區域配有座位、座位配備電腦、電話等，另設有多個小型討論室供實際運作時使用(圖三)。軟體部分，JDOC運用GIS圖層套疊系統及戰情儀表版(GIS Tools &Dashboard)，可依據不同事件於地圖顯示所需資訊，如火災、洪水、氣象、物資、行政中心及其聯絡人及重要統計資訊等，且可迅速、動態展示，並建立內部資訊網，提供授權使用者檢視各項報表、資訊及下載相關檔案。

過往JDOC參與之緊急事件包括於2021年加州野火中進行動物收容、照護相關緊急措施之協調、於2017及2018颶風侵襲時提供受災州之恢復及2016新大陸螺旋蠅(Cochliomyia hominivorax，Screwworm)入侵佛羅里達州疫情與2014年高病原性家禽流行性感冒滅除之資源協調工作，惟相關應變措施之規劃，仍有賴於APHIS內部主責單位之事先整備。相關內容詳如附件3。

四、 美國生物防治體之管理及應用

美國生物防治體計畫(Biological Control Program)係與其他合作者協同辦理輸入、篩選、釋放及監測生物防治體，以達成減緩擴散或管理具經濟性與環境重要性之入侵植物。

為防治入侵植物，首先需自原產地尋找適合的天敵、並於海外或於國內監管措施下進行寄主專一性測試、且輸入前需自向APHIS申請PPQ 256許可證後始得輸入。生物防治體施放前另需依據美國國家環境政策法（National Environmental Policy，NEPA）進行審查，以評估其對於環境之影響並建立飼育及純種(pure agent)之技術，完成初評後取得初級環境釋放許可(Pre-Environmental Release Permit)後可於田間進行施放，後續仍須進行監測、大規模飼育等工作評估，以取得後環境釋放許可(Post-Environmental Release Permit)。

於辦理生物防治體施放時，需由各州植物健康首長(State plant Health Director)

提出田間運營協議(Field Operation Agreements)，並與學術單位合作執行施放，除就入侵植物進行防治外，亦製作宣導說明圖冊，以強化民間溝通。為管理前揭運營協議，旨揭計畫成立國家運營經理(National Operations Manager)負責各式於田間運營協議，平衡各項用於生物防治之投資，包括田間施放、監測族群與防治效果，並確保良好的合作者可持續辦理計畫，並管考各計畫可如期、如質提送成果。近年前揭營運協議成功執行之防治對象包括Knotweeds(蓼科春蓼屬)、Orange hawkweed(黃花鼠耳菊)、Gorse (荊豆)、giant salvinia(槐葉蘋)等，各專案經費於10至90萬美元左右，相關內容詳如附件4。

五、 美國入侵果實蠅緊急防治

美國對於地中海果實蠅及墨西哥果實蠅主要採取全年性釋放不孕性成蟲技術進行防治，於美國本土(德州與夏威夷州，各一處)及海外(瓜地馬拉，兩處)建立生產設施、另於加州、德州及佛州各建立一處緊急設施，負責接收果實蠅蛹期並辦理後續施放動作。因為墨西哥為墨西哥果實蠅疫區，可透過自然散播方式傳入美國南方，相較地中海果實蠅而言防治更具難度。為此美國亦與墨西哥合作釋放不孕性果實蠅以協同防治。

入侵紐約之歐洲櫻桃實蠅目前尚未於美國發現危害櫻桃的紀錄，亦未於櫻桃產區發現，目前主要於金銀花(honeysuckle)上發現，紐約目前非屬櫻桃主要產區，主要進行櫻桃加工，然為防堵其擴散，美國劃定緊急防治區，限制櫻桃及金銀花等鮮果實移出管制區，同時持續採取監測作業，以確認其發生狀況。

面對極端事件可能導致果實蠅計畫中斷之預警措施包括增強設施調整釋放數量及次數、修正誘引器分布、面對逐漸溫暖的氣候，如何快速因應新偵測的果實蠅，如何掌握阻斷的管道並建立快速反應24-72-96小時的反應計畫。

六、 空間分析高級風險信息系統(SAFARIS)

APHIS與北卡羅來納州立大學作物有害生物綜合管理中心(NCSU Center for

Integrative Pest Management)合作開發，應用長期氣候資料及各種氣候預測模型結合有害生物與氣候相關之特性，預測近期(2週)、短程(1至5年)或大尺度(30至百年)有害生物適合分佈之區域。Dr. Yu本次以各種不同二氧化碳排放量模擬預測未來美國本土氣候上升情形，用以預測有害生物於美國適宜分佈，供決策單位參考。渠強調於應用SAFARIS時，病蟲害專家需要事先掌握有害生物與氣候關聯之關鍵因子(如昆蟲積溫)等，始能運用SAFARIS系統進行預測。CIPM亦將相關工具及預測成果置於網站(https://safaris.cipm.info)供公眾參閱。

七、 有害生物時空分布模型及防治輔助決策系統

APHIS與北卡羅萊納大學空間地理分析中心於2018年合作開發有害生物及病原分佈模型(Pest or Pathogen Spread Model，POPS)，目的係為促進研究學者、利害關係人及決策者更有效率的規劃經費投入於新興有害生物之防治策略。

系統以開源架構規劃，模擬有害生物擴散情形，並可將防治計畫納入運算參數，作為投資防治預算及防治措施之參考。其導入之圖層包括：地形圖(landscape)、環境資訊(environment，山脈、河流等)、物種分佈(all species)、寄主分佈(hosts)、氣象圖層(Weather)、有害生物起始分佈(initial infection)，導入有害生物繁殖、傳播速率、寄主感染率等參數之後，系統將依據有害生物之發生地點計算其繁殖情形、擴散至其他區域之潛能、擴散後感染新寄主之可能，並週而復始反覆計算，建立有害生物於預測時間區間內之空間分佈。決策者可於不同時間點將防治構想(如單點、區域、圍堵等)方式投入系統，系統將重新計算有害生物分佈與擴散情形，據以檢視防治成效預測及所需經費，提供決策參考。預測平臺目前尚在規劃上線中，相關資訊可至該網站(https://popsmodel.org/)查詢。

空間地理分析中心另開發3D地景展示系統，將POPS所預測之分佈情形藉由投影至解說平台，使現場與會者可於解說平臺結合3D地形模型更容易瞭解

有害生物分佈預測(圖十)，亦可將擬採取之防治區域直接標示於解說平臺，解說平臺上之3D攝影機可及時擷取影像回傳POPS系統，據以重新計算採取防治措施後之有害生物分佈情形，並顯示防治經費，藉由高度互動性強化決策者溝通，另該系統相關說明文件如附件5。

八、 北卡羅萊納州立大學植物蟲害診所參訪

北卡羅萊納州立大學植物病蟲害診所(Plant Disease and Insect Clinic，簡稱PDIC)，負責北卡羅萊納州國家公園、花圃、民間溫室、種苗場、農民、 園藝管理人、政府單位或家庭園藝操作人之植物疫病蟲害鑑定工作，並提供防治建議，2021年受理之診斷鑑定案件約有 2,820 件。案件受理包括照片(35%)、實體樣品(40%)及照片與實體樣品(25%)三類，最主要之作物為樹木與灌木類(28%)，其次為蔬菜與草本植物(14%)，相關辦理情形如附件6。該診所對於診斷鑑定除以照片鑑定者外，皆收取相關鑑定費用。該診所建立線上管理系統，功能包括案件受理與診斷鑑定結果登錄、報告產出與回覆、鑑定過程如有疑義亦可發送電郵詢問其他專家意見，相關回覆可在鑑定資料中查詢、鑑定過程相關內部紀錄亦可於系統內登打，供實驗室內部人員參考。

所有診斷的結果，亦上傳美國農業部與動植物檢疫署及國家植物診斷鑑定網（National Plant Diagnostic Network,簡稱 NPDN）。 該診所主要負責地區性診斷鑑定服務，故送件之有害生物，不一定會鑑定至「種」層級；如為未曾見過或有疑義者的有害生物，則送其他單位協助進一步鑑定。對於病毒類病害診斷，該診所係以寄主植物疾病徵先行研判可能之病毒種類，再以快速診斷試紙進行診斷，除非有進一步研究之必要，不另進行分子生物診斷。

肆、心得與建議

一、美國動植物防疫檢疫署近年為因應氣候變遷所導致農業生產力下降、極端氣候所導致之衝擊、環境正義及氣候變遷素養等議題制訂中長期之應變計畫，透過部門間之協調，以期共同達成目標。此外，並廣泛結合地理、氣候、生物學研析與建立各項預測模型及圖像化展示系統，強化使用者互動，除有效提供分析預測，亦強化風險溝通之效果，值得我國借鏡。另目前本局亦刻正建立植物疫情戰情中心，強化蒐集國際與國內相關疫情與因應作為，建議應持續加強與美方及其他相關國家植物保護機關之交流合作，以更完整掌握疫情資訊並及早採行必要之防檢疫措施。

二、APHIS之動植物緊急防控中心為近年新成立之單位，在相關之硬體設備方面與本局建置中之動植物疫情戰情中心規劃理念並無太大差異，惟該單位配有固定編制人員每日進行例行性相關動植物疫情資料之蒐集、彙整與研析工作，建議未來戰情中心亦應有適當充足之常駐人力，以持續有效進行疫情之蒐集與研析。

三、目前國際間雖已有部分植物有害生物發生與傳播之預測系統，惟皆有資訊來源、模型與其預測極限等限制，建議持續加強相關病蟲害流行學之研究，以建立符合我國氣候條件與作物栽培樣態之預測模型。

四、疾病時空傳播預測模型的建立有賴各領域專家之共同合作，目前國內獸醫部門對模型之建立並不熟悉，未來如何建立團隊並吸取國外經驗，藉由模型預測疾病好發之時間、地點，進而提前因應，為未來努力之方向。

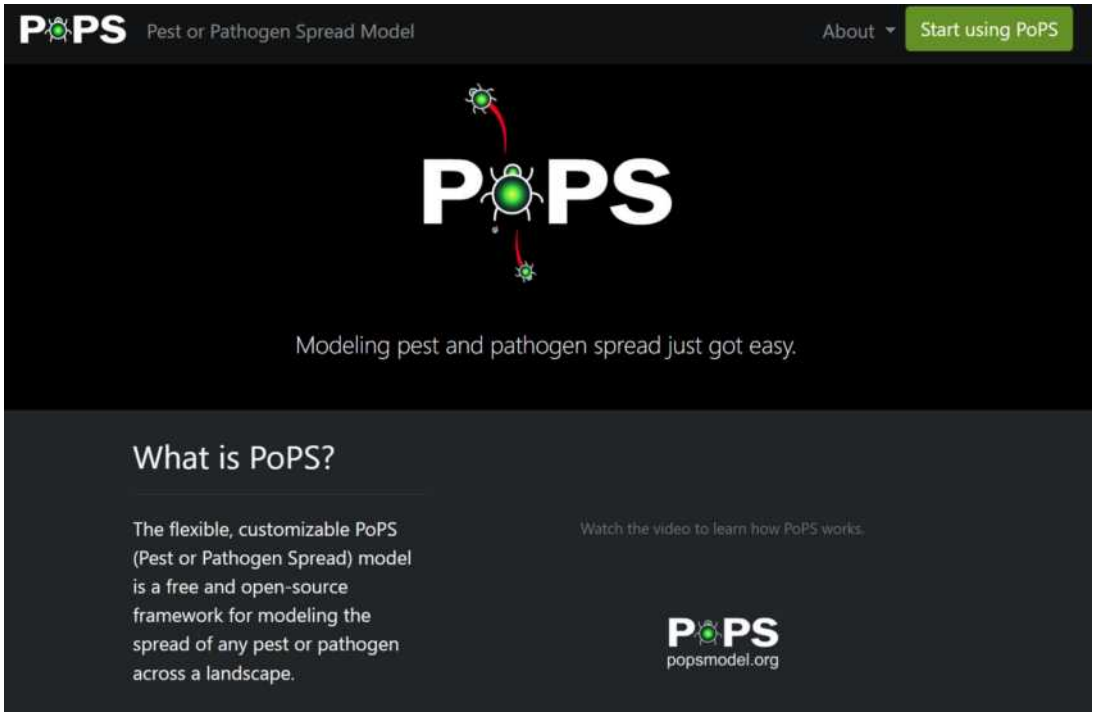
伍、參考網路資源

一、空間分析高級風險信息系統(SAFARIS)

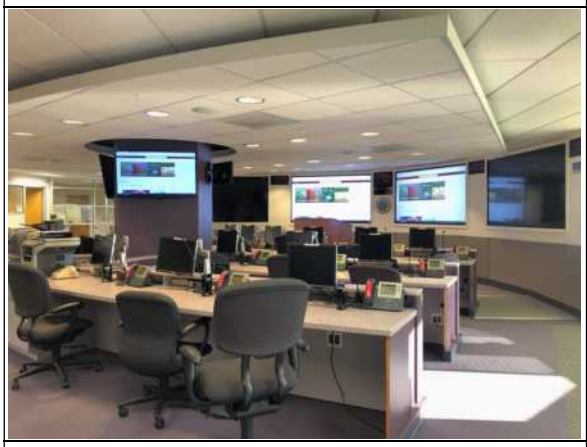
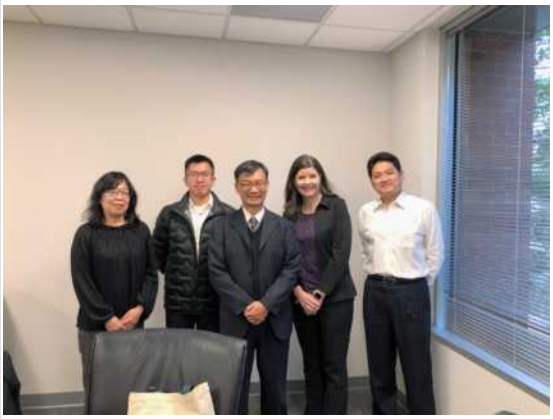
https://safaris.cipm.info/safarispestmodel/StartupServlet?safarishome

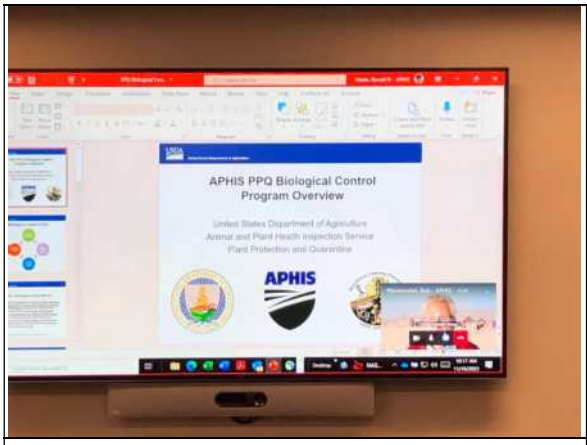
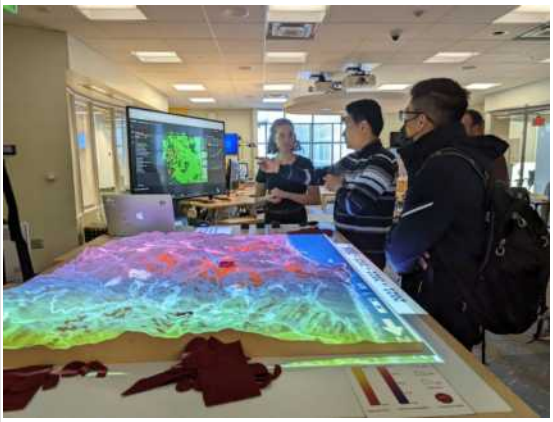
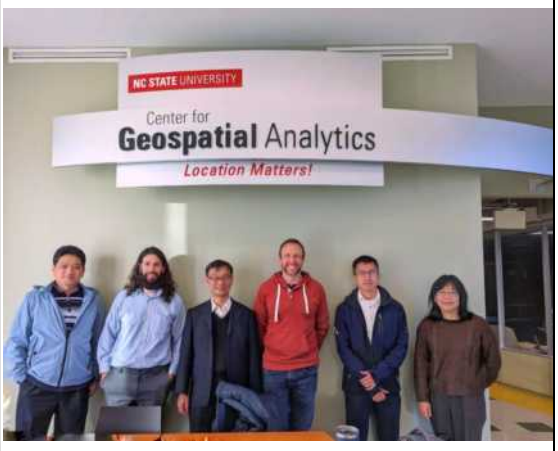
二、有害生物及病原分佈模型(Pest or Pathogen Spread Model，POPS)

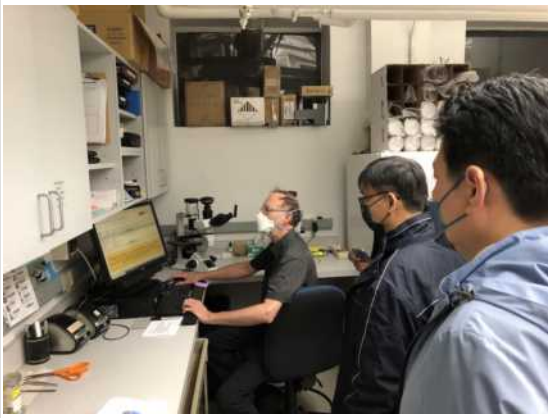
https://popsmodel.org/



陸、附圖

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>圖一、Dr. Glenn Fowler(屏幕左一)與 Ms. Hon. Hilda Diaz-Soltero(屏幕左二)介紹氣候變遷與植物健康及氣候變遷調適計畫</td><td>圖二、Mr. Justin Salus(右一)介紹 APHIS 緊急防控中心</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>圖三、APHIS 緊急防控會議室：配有大型液晶、不斷電系統、各座位配備電腦、電話等。</td><td>圖四、參訪 APHIS 緊急防控中心後與美方專家合影。</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>圖五、參訪北卡羅萊納州立大學 Centennial 校區之 APHIS 辦公室，由 Dr. Wendy W. Jin 介紹(左二)介紹相關業務</td><td>圖六、Ms. Tara Holtz(右二)分享美國入侵果實蠅緊急防治後合影</td></tr>
</table>

	
圖七、Dr. Robert Pfannenstiel(視訊)介紹美國生物防治體之管理及應用	圖八、參訪 APHIS 於北卡羅萊納州立大學之圖書室，相關植物病蟲害專書、圖鑑等藏書豐富。
	
圖九、Dr. Chris Jones(左一)介紹有害生物時空分布模型	圖十、北卡羅來納州立大學空間地理分析中心研究人員介紹有害生物時空分布模型實務操作
	
圖十一、北卡羅來納州立大學空間地理分析中心研究人員介紹 Tangible 輔助決策系統實務操作	圖十二、與北卡羅來納州立大學空間地理分析中心專家合影

	
圖十三、，Dr. Matt Bertone(左二)及 Mr. Mike Munster(左一)介紹北卡羅萊納州立大學植物蟲害診所實務及病毒快速診斷試劑	圖十四、Mr. Mike Munster(左一)介紹北卡羅萊納州立大學植物蟲害診所之診斷鑑定系統
	
圖十五、北卡羅萊納州立大學植物蟲害診所一隅，樣品清洗區寬敞且水槽下具有廢水回收設備。	

柒、附件

附件名稱

附件 1、美國動植物防疫檢疫署因應氣候變遷調適計畫

附件 2、北美植物保護組織(NAPPO)氣候變遷議題相關計畫

附件 3、APHIS 緊急防控中心(JDOC)介紹

附件 4、美國生物防治體計畫(Biological Control Program)

附件 5、北卡羅萊納大學空間地理分析中心 3D 地景展示系統介紹

附件 6、北卡羅萊納州立大學植物蟲害診所 2021 年業務介紹

USDA Animal and Plant Health Inspection Service
Climate Change Adaptation Plan

Presentation to Taiwan Trade delegation by Hilda Díaz-Soltero, November 2022

Introduction

The USDA Action Plan for Climate Adaption and Resilience provides the framework for the APHIS Climate Change Adaptation Plan. The USDA Plan covers activities from October 2021 to October 2023. It will be updated in 2023 to have a new Plan from Oct 2023 to Oct 2025,

The APHIS Climate Change Adaptation Plan is a living document that will be regularly updated. It includes actions from April 2022 to 2025. The Plan describes APHIS mission and goals, identifies how climate change may impact goals, and adaptation and mitigation actions to address impacts.

Climate Change Effects and Vulnerabilities

In assessing the impacts of climate change, APHIS found that climate change could pose challenges to two of the Agency's Strategic Goals:

- Goal 2, *Safeguard American agriculture*
- Goal 3, *Facilitate safe US agricultural export*

Potential effects to APHIS corresponded with two of the five vulnerabilities identified in the USDA Adaptation Plan:

- Decreased Agricultural Productivity
- Shocks Due to Extreme Climate Events

Climate Adaptation Actions include ongoing, planned, and proposed new efforts to mitigate and adapt to the effects of climate change and to build resilience in the Agency.

Decreased agricultural productivity

Shifts in Geographic Distribution of Wildlife, Weeds, Pests, and Diseases.

Develop methods and procedures to sample for new zoonotic or agriculturally significant diseases in wildlife

Complete climate suitability maps that predict the changing suitability of an area for pest or disease occurrence.

Identify, monitor, and prevent introduction of animal and plant pests and diseases into the United States.

U.S. Agricultural Production and Trade.

Monitor and accelerate work related to pollinator health

Research alternatives to methyl bromide, an ozone-depleting compound that exacerbates climate change.

Continue to research and safely release biological control agents of invasive species.

Continue the implementation of trade policies that encourage legal trade of timber and timber products.

Encourage collaboration with the World Organization for Animal Health (OIE) and the International Plant Protection Convention (IPPC) on climate change-related initiatives.

Seek additional collaboration with trading partners on climate change-related initiatives, such as actions to build capacity to identify, control, manage, and eradicate certain pests and diseases, and to establish and manage sustainable animal and plant health programs.

Increased Demand for Plants Developed Using Genetic Engineering and Other APHIS Services.

Evaluate APHIS' regulatory framework for the movement and release of organisms developed using genetic engineering and support the development of climate-adapted crops.

Use forecasting models to assess changes in the distribution of modified organisms.

Shocks Due to Extreme Climate Events

Emergency Response Systems.

Ensure continuity of operations.

Reinforce animal and plant health emergency frameworks.

Prepare responses to assist producers in advance of a pending severe weather event. Plan for potential large-scale animal mortality events that will require transportation and disposal plans.

Develop a webpage to help with contingency plans for the handling of animals during emergencies.

Food Distribution and Aid.

Enhance capacity to meet challenges related to food distribution and aid.

Cross-Cutting Adaptation Issues

Environmental Justice

Identify underserved communities and specific issues within those communities related to climate change.

Identify opportunities to support and encourage more climate-resilient investments in underserved communities.

Workforce Climate Literacy

APHIS seeks to enhance climate literacy for employees, producers, farmers, and other stakeholders

Identify potential training and informational resources for employees.

Identify existing and develop new training modules regarding climate change to incorporate into AgLearn.

Encourage participation in USDA's Climate Science Seminar Series.

USDA Climate Hubs

Develop informational resources on USDA and APHIS related climate change actions and initiatives in coordination with Climate Hubs.

IMPLEMENTATION of APHIS Plan

The table below includes actions and the following information for each:

- Climate vulnerability addressed
- Action (task) description
- Type of activity
- Lead APHIS Office to implement it
- Timeframe
- External coordination entities
- Metrics to measure progress
- Accomplishments to date

I have highlighted in blue some actions that Taiwan may consider in their own efforts related to climate change mitigation and resilience.

Table 1 APHIS adaptation actions to address climate change effects and vulnerabilities

Climate Vulnerability	Action Title/Description	Type of Activity	Lead Office	Timeframe	APHIS External Coordination	Progress Metrics	Accomplishments to Date
Impacts to agricultural productivity	Develop methods and procedures to sample for new zoonotic or agriculturally significant diseases in wildlife	Ongoing	Veterinary Services, Wildlife Services	Ongoing	NA	# of zoonotic and agricultural diseases sampled in wildlife	APHIS currently reports on 15 diseases in wildlife populations
Impacts to agricultural productivity	Complete climate suitability maps that predict the changing suitability of an area for pest or disease occurrence	Ongoing	Plant Protection and Quarantine	Ongoing	Academia	# of priority pests for which climate suitability maps have been completed	APHIS currently has 6 climate suitability maps
Impacts to agricultural productivity	**Identify, monitor, and prevent introduction of animal and plant pests and diseases** into the United States	Ongoing	Plant Protection and Quarantine, Veterinary Services	Ongoing	U.S. Customs and Border Protection (CBP), and other Federal, State, and Tribal Partners	# of inspections, # of seizures, # of outreach events and materials	Ongoing work
Impacts to agricultural productivity	**Enhance systems for monitoring invasive species, as well as vector and disease spread**	Ongoing	Plant Protection and Quarantine, Veterinary Services, Wildlife Services	Ongoing	International Partners	# of system enhancements	Ongoing work
Impacts to agricultural productivity	Enhance information sharing on forest pest and diseases	Ongoing	Plant Protection and Quarantine	Ongoing	U.S. Forest Service	# of info resources shared	Ongoing work
Impacts to agricultural productivity	Monitor and accelerate work related to pollinator health	Ongoing	Plant Protection and Quarantine	Ongoing	OCS, ARS, State Partners, Academia	# of National Honey Bee Disease Surveys	Annual survey since 2009
Impacts to agricultural productivity	Research alternatives to methyl bromide	Ongoing	Plant Protection and Quarantine, Policy and Program Development	Ongoing	ARS, Academia	# of alternatives researched	Ongoing work
Impacts to agricultural productivity	Continue to research and safely release biological control agents	Ongoing	Plant Protection and Quarantine, Policy and Program Development	Ongoing	ARS, Academia	# of biological controls under testing and released	Ongoing work
Impacts to agricultural productivity	**Continue the implementation of trade policies that encourage legal trade of timber and timber products**	Ongoing	Plant Protection and Quarantine	Ongoing	U.S. Fish and Wildlife Service, CBP	# of declarations, # of seizures	Ongoing work
Impacts to agricultural productivity	**Encourage collaboration with the OIE on climate change-related initiatives**	Proposed	Veterinary Services	TBD	OIE	# of meetings, # of actions	NA

Impacts to agricultural productivity	**Continue collaboration with the IPPC on climate change-related initiatives**	Ongoing	Plant Protection and Quarantine	Ongoing	IPPC	# of meetings, # of actions	Focus Group on Climate Change and Phytosanitary Issues was established in April 2021
Impacts to agricultural productivity	**Seek additional collaboration with trading partners on climate change-related initiatives**	Proposed	International Services	TBD	International Partners	TBD	NA
Impacts to agricultural productivity	Evaluate APHIS regulatory framework for the movement and release of organisms developed using genetic engineering and support the development of climate-adapted crops	Proposed	Biotechnology Regulatory Services	TBD	NA	TBD	NA
Impacts to agricultural productivity	Explore and use forecasting models to assess potential changes in the distribution of modified organisms.	Proposed	Biotechnology Regulatory Services	TBD	TBD	TBD	NA
Impacts to agricultural productivity	Ensure that proposed regulated field trials remain outside of environmentally sensitive areas	Ongoing	Biotechnology Regulatory Services	Ongoing	NA	# of reviews	Ongoing work
Shocks Due to Extreme Climate Events	**Ensure continuity of operations**	Ongoing	Emergency and Regulatory Compliance Services	Ongoing	NA	NA	Ongoing work
Shocks Due to Extreme Climate Events	Reinforce animal and plant health emergency frameworks	Ongoing	Emergency and Regulatory Compliance Services	Ongoing	Federal, State, Tribal Partners	# of reviews, # of frameworks developed or updated	Ongoing work
Shocks Due to Extreme Climate Events	Prepare responses to assist producers in advance of pending a severe weather event.	Ongoing	Emergency and Regulatory Compliance Services	Ongoing	Federal, State, Tribal Partners	TBD	Ongoing work
Shocks Due to Extreme Climate Events	Develop a webpage to help with contingency plans for the handling of animals during emergencies	Proposed	Animal Care, Legislative and Public Affairs	TBD	TBD	TBD	NA
Shocks Due to Extreme Climate Events	Enhance capacity to meet the challenges related to food distribution and aid	Proposed	Emergency and Regulatory Compliance Services	TBD	Federal, State, Tribal Partners	TBD	NA
Environmental Justice	Review internal and external data to **identity underserved**	Proposed	Office of Civil Rights, Diversity, and Inclusion;	TBD	Federal, State, Tribal Partners, and Academia	TBD	NA

	communities and issues related to APHIS programs		Policy and Program Development				
Environmental Justice	Conduct outreach to and increase access for underserved communities to better understand and address issues.	Ongoing	Office of Civil Rights, Diversity, and Inclusion; Legislative and Public Affairs	Ongoing	Federal, State, Tribal Partners, and Academia	# of events attended, # of stakeholder consultations	Ongoing work
Environmental Justice	Develop a unified approach on how to address climate change impacts in environmental compliance documents	Proposed	Policy and Program Development	TBD	TBD	TBD	NA
Environmental Justice	Increase opportunities and climate-resilient investments in underserved communities	Ongoing	Office of Civil Rights, Diversity, and Inclusion; Legislative and Public Affairs; Marketing and Regulatory Programs Business Services	Ongoing	Federal, State, Tribal Partners, and Academia	# of events attended, # of cooperative agreements	Ongoing work
Climate Literacy	**Identify existing and develop new training modules regarding climate change** to incorporate into AgLearn	Proposed	Marketing and Regulatory Programs Business Services	TBD	TBD	TBD	NA
Climate Literacy	Develop informational resources on USDA and APHIS related climate change actions and initiatives	Proposed	Office of the Administrator, Legislative and Public Affairs	TBD	TBD	TBD	NA
Climate Literacy	Participate in USDA's climate literacy working group	Proposed	Office of the Administrator	TBD	TBD	TBD	NA

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NAPPO and Climate Change

Stephanie Dubon
PPQ International Phytosanitary Standards

November 14, 2022

NAPPO
North American Plant Protection Organization
Organización Norteamericana de Protección a las Plantas
MEXICO - USA - CANADA

USDA United States Department of Agriculture

Overview

- What is NAPPO?
- Climate Change and Harmonization
- New Strategic Plan
- NAPPO Annual Meeting Symposium

About NAPPO

- North American Plant Protection Organization (NAPPO)
- The regional plant protection organization (RPPO) for North America, representing Canada, the United States, and Mexico

NAPPO
North American Plant Protection Organization
Organización Norteamericana de Protección a las Plantas
MEXICO - USA - CANADA

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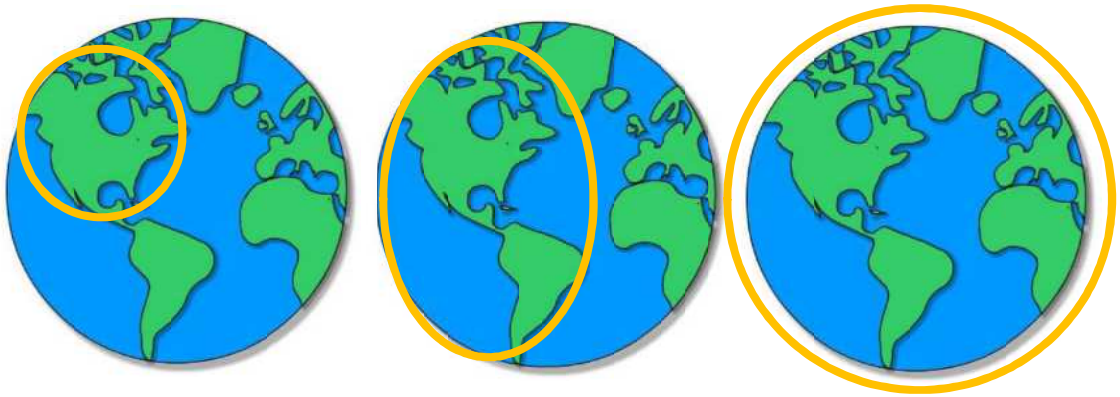
Established in 1976, NAPPO has

regional **as well as** ***hemispheric*** **and** ***global*** **functions**



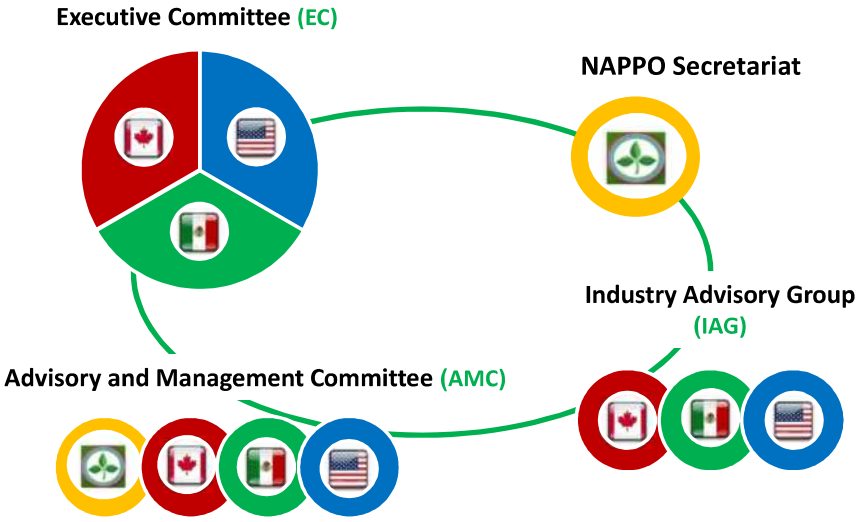
NAPPO regional functions

NAPPO provides a regional forum for **public (government) and private (industry)** sectors in Canada, the United States and Mexico to collaborate in the protection of all plant resources and the environment while facilitating safe trade.

Other regional functions

- **NAPPO facilitates the development of** Regional Standards for Phytosanitary Measures - **RSPMs** - and **other harmonization documents** (Science & Technology, discussion, position, decision, protocols)
- These **provide guidance to member countries** on harmonized approaches to phytosanitary measures thereby facilitating safe movement of plants, plant products and other regulated articles into and within the region

The NAPPO Management Team (NMT)



NAPPO Documents on Climate Change

- NAPPO Discussion Document 3: Climate Change and Pest Risk Analysis (PRA), 2011
- NAPPO Position Paper 5: Climate Change and Pest Risk Analysis (PRA), Technical Summary, 2012

New NAPPO Strategic Plan

- Approved July 13, 2022
- Covers 2022-2026
- Includes for NAPPO, Member Countries, and Stakeholders:
  - Mission Statement
  - Overarching Challenges and Opportunities
  - Strategic Goals
- Bigger picture, stretch goals
- The NAPPO Annual Work Program includes the projects to help us achieve the goals in the plan

Link: https://www.nappo.org/

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New NAPPO Strategic Plan

Climate Change as a Challenge

Addressing and responding to threats to biodiversity and the environment, including impacts of climate change. Beyond agricultural production, invasive pests continue to pose a threat to wild flora, forests, and ecosystems at large. This threat will be exacerbated by changes in climate which are expected to lead to geographical expansion of pest distributions, more frequent pest introductions, changes in pest outbreak patterns, and development of new or expanded endangered areas, as well as facilitate potential opportunities for growing new crops in new areas, which may result in presently unknown pest risks. Responding to these challenges while managing the volume and reliability of information on these issues is a concern for all plant protection organizations, including NAPPO.

New NAPPO Strategic Plan

Climate Change Goal

1. Protect North American plant resources, including the environment, from the introduction and spread of regulated plant pests.

c. Address the impacts of climate change by collaborating with the IPPC, NPPOs, and RPPOs, and consider how NAPPO can play a role in mitigating its impact on plant health and pests.

NAPPO Annual Meeting

- October 18-20, 2022, fully virtual
- Canada hosted
- 350 participants from 19 countries
- Seminar on Climate Change
- Government and Industry Expert Presenters
- Video presentations are publicly available at nappo.org

2022 NAPPO Annual Meeting

Seminar on Climate Change:

- Updates on IPPC work and Focus Group
- NAPPO work to-date
- U.S., Canada, and Mexico plans and policies on climate change, including U.S. tools (SAFARIS)
- U.S., Canada, and Mexico industry experiences
- Panel Discussion and Question and Answer

Contact Info

Stephanie Dubon

PPQ NAPPO Technical Director

Stephanie.M.Dubon@usda.gov

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North American Plant Protection Organization
Organización Norteamericana de Protección a las Plantas
MEXICO - USA - CANADA

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USDA & APHIS Organization Overview

USDA

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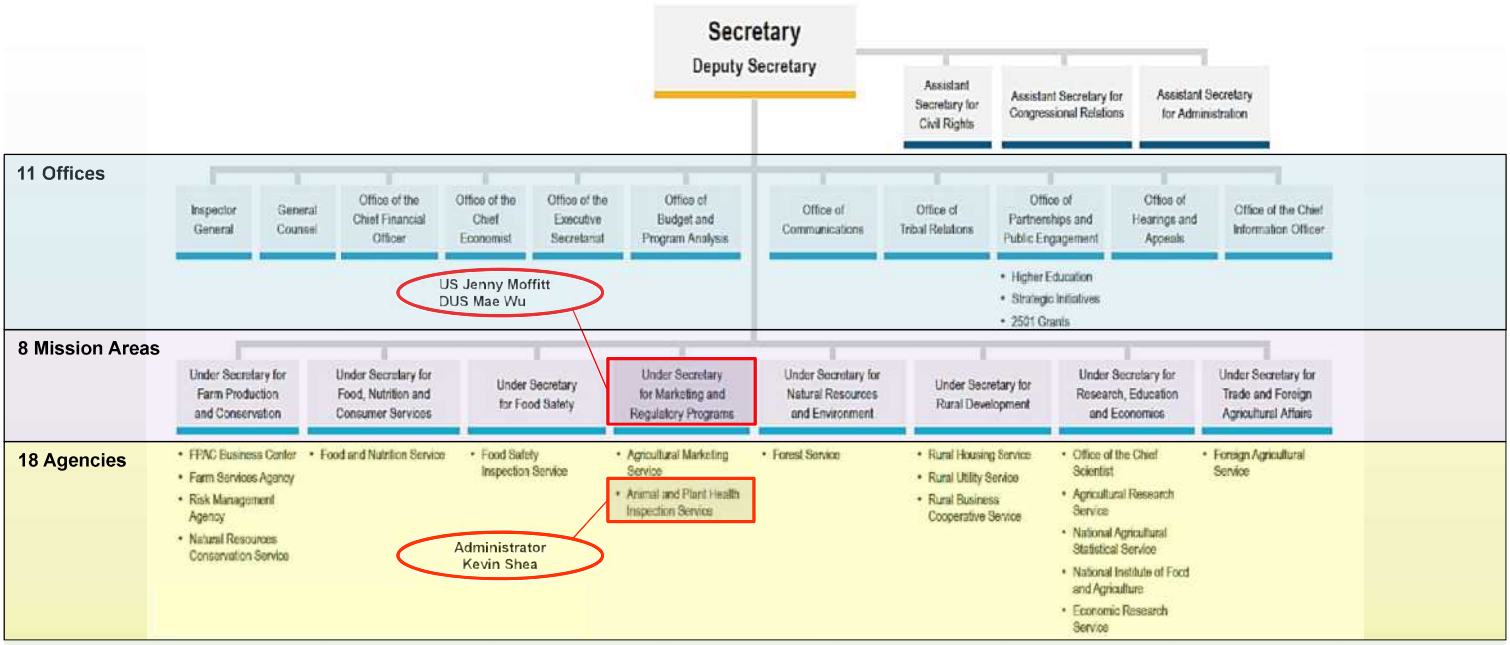
USDA Organization



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APHIS Organization

APHIS Program Info
8200 total staff

Office of the Administrator
9

4 Support Units
1 Office

- MRP Business Services — 686
- Policy & Program Development — 103
- Legislative & Public Affairs — 74
- Emergency & Regulatory Compliance Services — 191
- Office of Civil Rights, Diversity, & Inclusion — 26

6 Operational Programs

- Animal Care — 207
- Biotechnology Regulatory Services — 78
- International Services — 103
- Wildlife Services — 1988
- Veterinary Services — 1839
- Plant Protection & Quarantine — 2896

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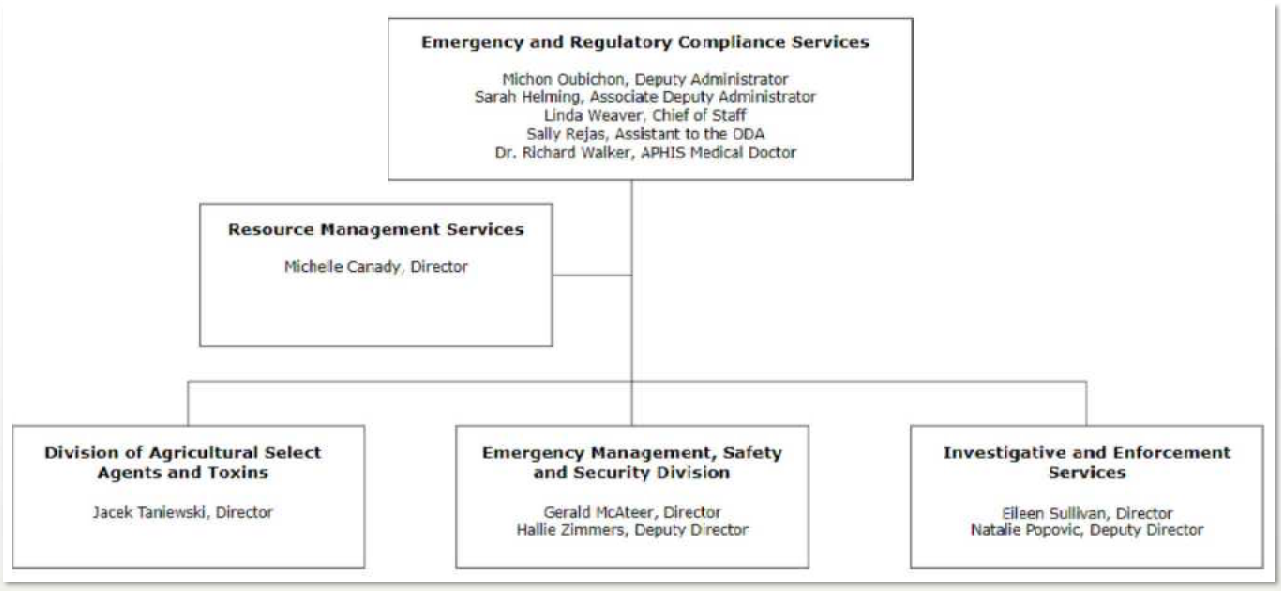
ERCS Organization



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APHIS Dr. Jere L. Dick Operations Center (JDOC) Capabilities Overview

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Operations Center Purpose

JDOC is staffed 24/7 by the APHIS Duty Officer.
Populates the APHIS common operational picture.
Primary conduit for information flow in and out of APHIS.
Provides daily reporting to USDA and APHIS Senior Leadership.

JDOC facilitates

- Information collection, analysis, and dissemination
- Continuity of operations and devolution coordination
- Communications capabilities
- Interagency communication
- Significant event reporting
- Response coordination

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JDOC Capabilities Overview

JDOC equipment is tested quarterly. Last major upgrade was in 2015.
JDOC space capability consists of the following:

- 21 workstations
- 1 AMX Controller
- 2 Industrial paper shredders
- 4 Video tele-conference units
- 4 Large displays
- 2 Analog (copper wire) phones
- 33 VoIP Phones
- 2 fax machines
- 11 Networked printers
- 1 Copy Machine
- 5 Satellite radios
- Office supplies cache
- Wi-Fi and wired network access
- Emergency power generator
- Satellite television

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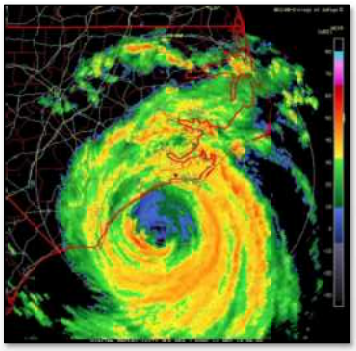
Historical Responses



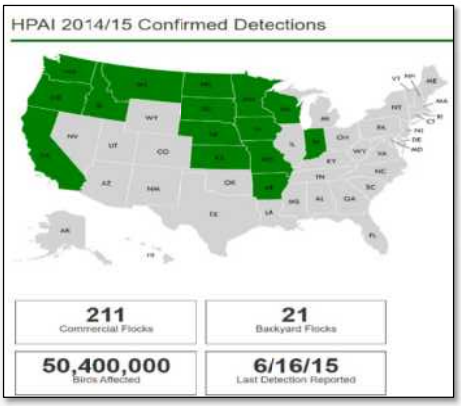
2021 California Wildfires

- In 2021, APHIS provided Agriculture support to a major fire disaster for animal care and sheltering operations. APHIS resource coordination was conducted virtually from JDOC to support incident command on the ground.

2017 & 2018 Hurricanes

- In 2017 and 2018, APHIS utilized the JDOC while responding to hurricanes Michael, Florence, Maria, Irma, and Harvey, providing Federal disaster recovery assistance in impacted regions.

Historical Responses



2016 Florida Keys Screwworm Outbreak

- APHIS announced the confirmation of New World Screwworm in Key Deer in the Florida Keys. It had been eradicated from the U.S. more than three decades ago, and this was the first infestation in Florida in 50 years.

2014 Highly Pathogenic Avian Influenza

- In 2014 & 2015, APHIS responded to eradicate a severe U.S. outbreak of HPAI. APHIS resource coordination was conducted virtually from the JDOC.

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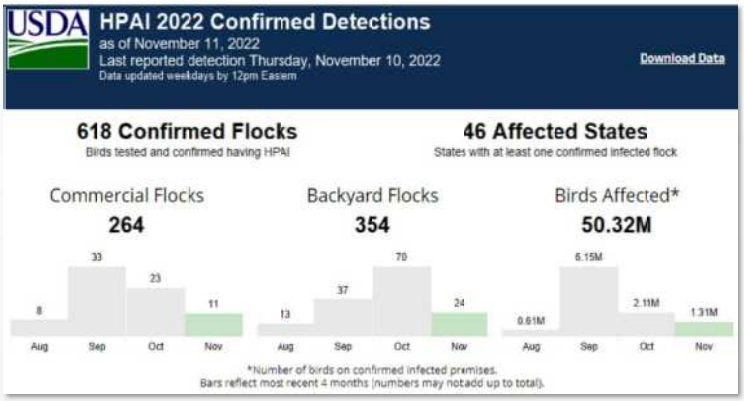
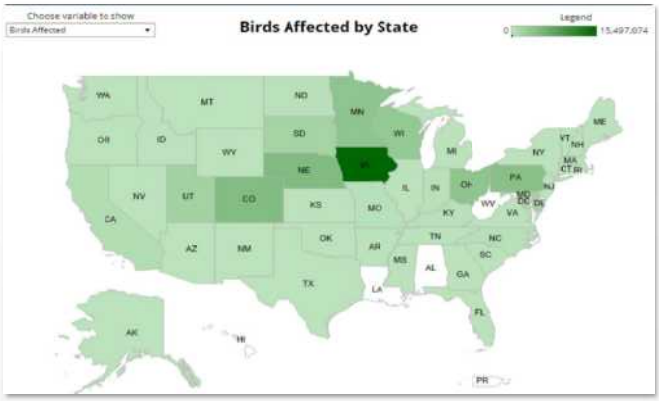
Ongoing HPAI Response





OPERATIONS

- Safety worked on a message to all employees with information on expedited clearance appointments, reminding them to prioritize HPAI blood work only and for employees to fast before their appointment.

COORDINATION & LIAISON

- VS leadership had a call with FEMA last week and there was some discussion about how FEMA could assist. Topics included FEMA temporary housing to offset cost per diems historical cost analysis of FEMA housing vs. per diem to baseline information.

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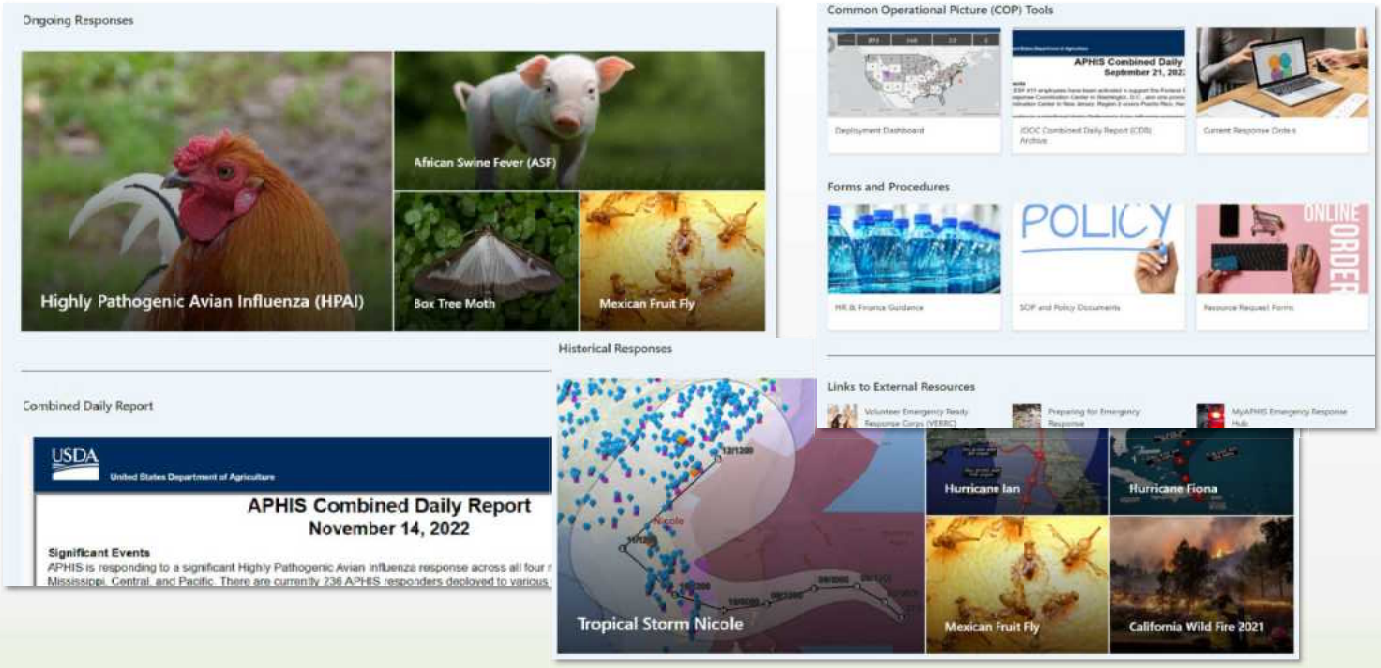
Online Common Operational Picture



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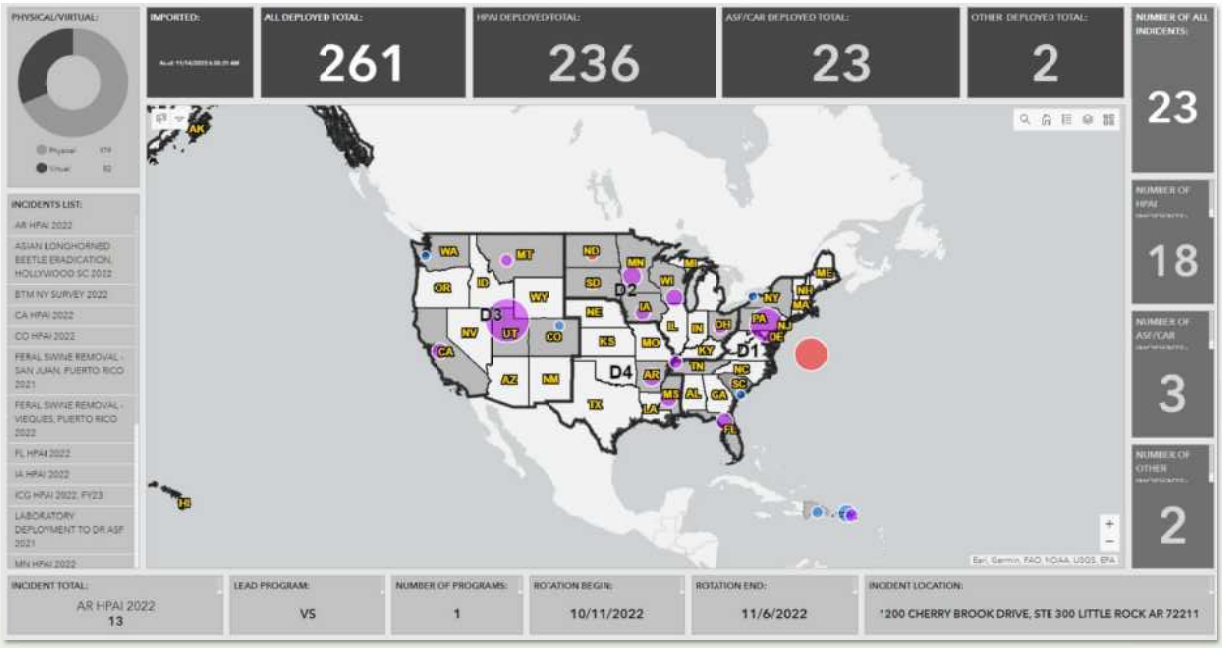
GIS Tools & Dashboards



Emergency Support Function #11 Overview

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Statutory Authority versus Stafford Act

Statutory Response Activity

- The activities that fall under the authority and funding of the agency – what they have been authorized and appropriated to do, by law.

Stafford Act Response Activity

- Allows the Governor (through a request for a Presidential declaration) to obtain federal government resources to assist in a disaster. Enables the Federal Emergency Management Agency (FEMA) to task federal agencies to respond.

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All-Hazards Preparedness and Response

FEMA can activate, nationally or regionally, for all types of threats and hazards, ranging from accidents, technological hazards, natural disasters, and human-caused incidents. Some examples are:

- Hurricanes
- Wildfire
- Flooding
- Earthquakes
- Tornados
- Tsunami
- Pandemic
- Radiological Incidents
- Train derailments

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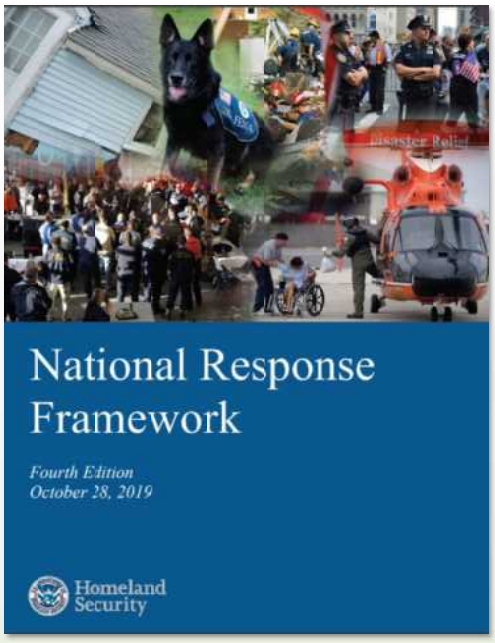
National Response Framework



Emergency Support Functions

Emergency Support Functions (ESFs) provide the structure for coordinating Federal interagency support for a Federal response to an incident. They are a way to group functions that provide federal support to states and federal-to-federal support, both for Stafford Act declared disasters and emergencies and for non-Stafford Act incidents.

ESF #1: Transportation

ESF #2: Communications

ESF #3: Public Works and Engineering

ESF #4: Firefighting

ESF #5: Information and Planning

ESF #6: Mass Care, Emergency Assistance, Temporary Housing, and Human Services

ESF #7: Logistics

ESF #8: Public Health and Medical Services

ESF #9: Search and Rescue

ESF #10: Oil and Hazardous Materials Response

ESF #11: Agriculture and Natural Resources Annex

ESF #12: Energy

ESF #13: Public Safety and Security

ESF #14: Cross-Sector Business and Infrastructure

ESF #15: External Affairs

- ESF #15 Standard Operating Procedures (2019)

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ESF #11's Role

Coordinates a variety of functions designed to protect the Nation's food supply, respond to pest and disease incidents impacting agriculture, and protect natural and cultural resources. Functions include but are not limited to the following:

- Nutrition assistance
- Agricultural disease and pest response
- Meat, poultry, and processed egg products safety and defense
- Natural and cultural resources and historic properties protection
- Technical expertise, coordination, and support of animal and agricultural emergency management

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Functional Categories and Responsibilities

Functional Category	ESF Primary Agency	Primary Tasks
Nutrition Assistance	USDA/Food and Nutrition Service (FNS)	Providing nutrition assistance
Animal and Plant Disease and Pest Response	USDA/Animal and Plant Health Inspection Service (APHIS)	Responding to animal and agricultural health issues
Commercial Food Supply Safety and Security	USDA/Food Safety and Inspection Service (FSIS)	Ensuring the safety and defense of the Nation's supply of meat, poultry and processed egg products
Natural and Cultural Resources and Historic Properties	Department of Interior	Protecting Natural, Cultural, and Historical (NCH) resources
Safety and Well-Being of Household Pets	USDA/APHIS	Providing technical expertise in support of animal and agricultural emergency management

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ESF #11 Regions

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ESF #11 Coordinator Duties

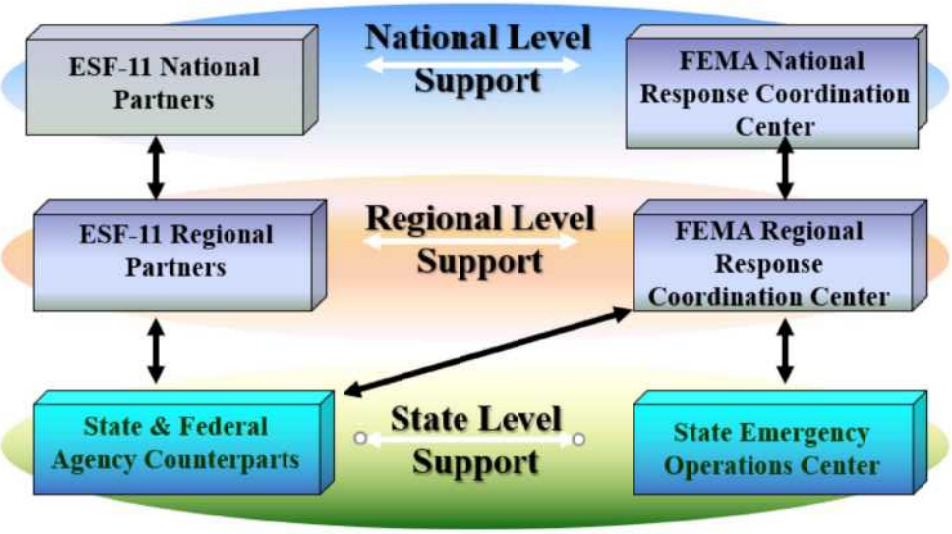
Day to day

- Maintaining awareness
- Preparedness Activities
- Establishing relationships
- Training/Exercises
- Reviewing plans
- Providing ESF #11 expertise

Disaster Response

- Represent ESF #11 in Coordination Centers
  - In meetings, conference calls
- Liaison between USDA and FEMA
- Communication and reporting

Communication Chains



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Recent ESF #11 Regional Activations

- Regions 3 & 4 - September 2022 - Hurricane Ian
- Region 2 - September 2022 - Hurricane Fiona
- Region 4 - July 2022 - Kentucky Flash Flooding
- Region 8 - June 2022 - Montana Flash Flooding
- Region 6 - May 2022 - New Mexico Fire
- Region 8 - December 2021 - Colorado Wildfire*
- Region 4 - December 2021 - Kentucky Severe Weather

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The APHIS Biological Control Program

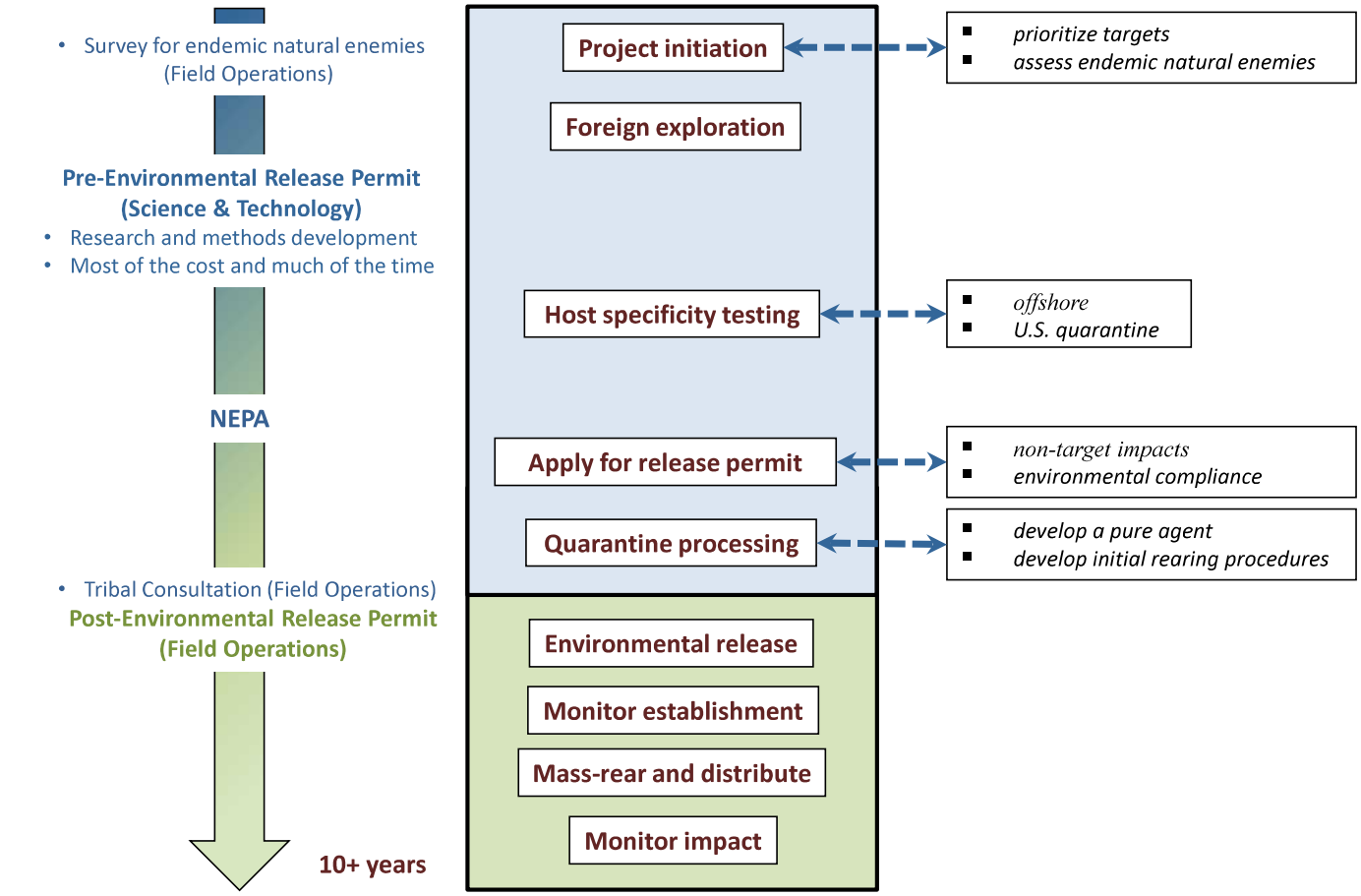
Operational Challenges and Opportunities

Keith Colpetzer
USDA, APHIS, PPQ
National Operations Manager

USDA United States Department of Agriculture

Who's the new kid on the block?

- Assumed responsibility FY18
- Aquatic Entomologist
- Nursery Inspector
- Research Assistant
- Risk Analyst
- National Operations Manager
- BS in Biology - WCU of PA
- MS in Entomology - U of DE
  - Judy Hough-Goldstein
  - Michael Smith ARS-BIIRL
  - BC of MAM (*Persicaria perfoliata*)
  - Rapid germination of *P. perfoliata*
  - Host specificity of *Rhinoncomimus latipes*
  - Feeding and oviposition behavior of *R. latipes*



The APHIS Biological Control Program

Mission

- work with cooperators to import, screen, release, and monitor BC agents that can slow the spread or help manage economically or environmentally important invasive plant pests

- Plant Protection Act

"biological control is often a desirable, low-risk means of ridding crops and other plants of plant pests and noxious weeds, and <u>its use should be facilitated by the Department of Agriculture, other federal agencies, and states whenever feasible</u>."

- <u>facilitate</u> biological control in the United States

Field Operations Agreements: Funding Process

- Request for proposals
  - State Plant Health Directors
- Proposal Evaluation
  - NPPO priorities
  - Program priorities
  - Core Functional Area priorities
  - Evaluate Intention
  - Evaluate Feasibility, Importance, and Potential Impacts
  - Assign Numerical Score, Rank, Communicate Decision
- Finalizing agreements

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National Operations Manager

- Responsible for maintaining a diverse portfolio of cooperative agreements that implement biological control on the ground and in the field.
- Responsible for balancing biological control investments among maintaining beneficial organisms for field releases, monitoring the establishment and impact of recently released natural enemies, and establishing field populations of agents that attack emerging pests.
- Responsible for ensuring that good cooperators have viable projects and that all cooperators are delivering the products specified in their work plans.

National Operations Manager

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National Operations Manager

Field Operations Agreements: Success
University of Alaska

- **Building Capacity**
  - Initial Investment FY20
    - Invasive knotweeds FY20-22
    - Orange hawkweed FY22
  - Total Investment $90,000
- Facilitated Biocontrol
- Distribution Maps
- Knowledge of Community Awareness and Acceptance
- Developed Partnerships
  - Leverage existing expertise
  - Leverage opportunities to achieve goals more rapidly
- First potential release in AK
- Preserve and Protect

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Field Operations Agreements: Success
Cornell Cooperative Extension of Niagara County

- **Building Capacity & First Release**
  - Initial Investment FY20
    - Invasive knotweeds FY20-22
  - Total Investment $109,436
- Facilitated Biocontrol
- Distribution Maps
- First Releases in Western NY
  - July and September of 2022
- Leverage Expertise & Infrastructure
  - Heated Greenhouses
  - Professional Staff
  - Community Support
  - Volunteers – Free Labor!!!
- Leverage opportunities to achieve goals more rapidly

Field Operations Agreements: Success
CDFA & Oregon State University

- **First Release & Establishment**
  - Initial Investment FY20
    - Gorse FY20-22
  - Total Investment $200,864
- First Releases in CA and OR
  - Summer of 2020
- Establishment in CA and OR
  - Andreas, Price, and Grevstad, 2022
- Leverage Expertise & Infrastructure
  - Experienced practitioners
  - Existing facilities
  - Existing cooperators
- Leverage opportunities to achieve goals more rapidly

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Field Operations Agreements: Success
LSU & University of Puerto Rico

- **Control**
  - Initial Investment FY20
    - Giant Salvinia FY20-21
  - Total Investment $152,785
- Facilitated Biological Control
- Restored Storm Water Management
- Restored Public Recreation
- Leverage Expertise & Infrastructure
  - Experienced practitioners
  - Existing facilities
  - Existing cooperators
- Leverage opportunities to achieve goals more rapidly

May 2019

October 2021

NC STATE UNIVERSITY

Center for **Geospatial** Analytics

DECISION ANALYTICS
PESTS & PATHOGENS

Decision analytics to control the spread of invasive pests and pathogens combine sophisticated mathematical models and user-friendly interfaces to help decision makers predict where problems are likely to spread and which interventions might be most effective.

With a tailored Tangible Landscape running the Pest or Pathogen Spread (PoPS) model of sudden oak death, stakeholders on the West Coast can collaboratively test management scenarios in a group setting. With the web-based PoPS interface, managers can iteratively explore how to allocate funds to contain economically important insect pests, such as spotted lanternfly in Pennsylvania.

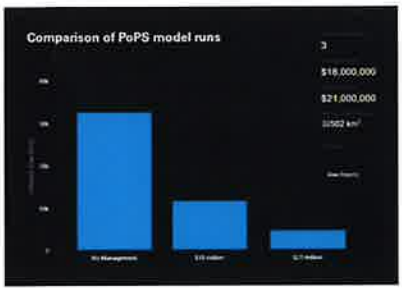
Research Team
Devon Gaydos, Dr. Chris Jones, Kellyn Montgomery, Dr. Anna Petrasova, Dr. Vaclav Petras, Dr. Payam Tabrizian, Dr. Ross Meentemeyer

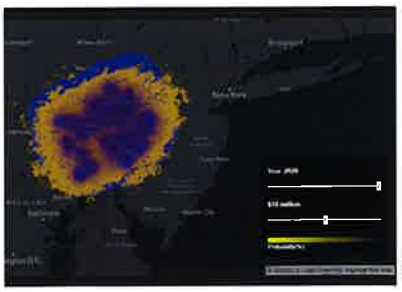
◀ How It Works

As an interactive disease simulation runs on Tangible Landscape, stakeholders place felt pieces on a physical model to mimic the removal of host plants, then receive real-time feedback about the consequent predicted spread of the disease. Multiple simulations can be run, testing different management strategies, and then compared using the PoPS dashboard.

How It Works ▶

After modifying parameters on the input page of the PoPS website, a user runs the spread simulation. An output dashboard then displays the results of the model runs and the effects of tested management, both graphically and through interactive maps.





For more info, check out...

Landscape Forecasting: geospatial.ncsu.edu/landscape-forecasting[48]
▶ with links to model details, user communities, and more

TANGIBLE LANDSCAPE

PoPS

Connect with us!

@NCSUgeospatial
geospatial.ncsu.edu

NC STATE UNIVERSITY

Center for
Geospatial Analytics

TANGIBLE LANDSCAPE

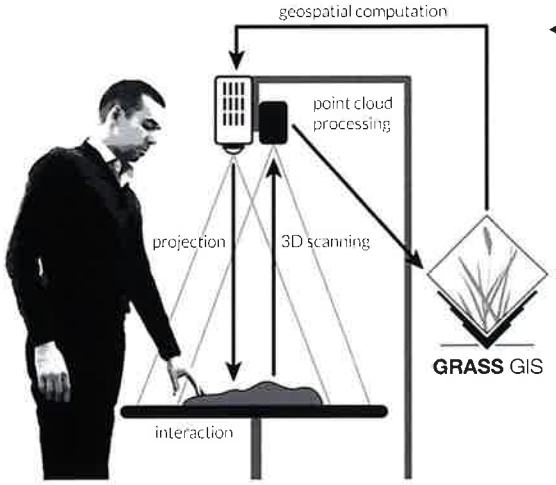
Tangible Landscape is an open source interface for 3D sketching powered by GRASS GIS.

The system couples a physical model of a landscape with a digital model of the same landscape in a geographic information system through a continuous cycle of 3D scanning, geospatial computation, and projection in near real time.

With this innovative technology, you can intuitively interact with processes such as water flow, erosion, solar radiation, flooding, fire spread, disease spread, and urban growth to experimentally test interventions. You can examine viewsheds, design trails, sculpt landforms, and more, even creating serious games for collaborative decision-making.

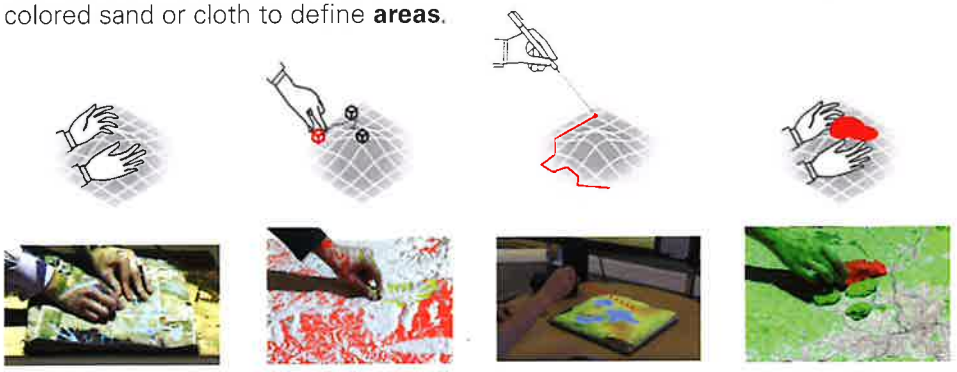
Research Team

Dr. Anna Petrasova, Dr. Payam Tabrizian, Dr. Vaclav Petras, Garrett Millar, Dr. Brendan Harmon, Dr. Helena Mitasova



◀ How It Works

You can interact with Tangible Landscape in many ways: **sculpt** the surface with Kinetic Sand, place markers as **points**, draw **lines** with a laser pointer, or place colored sand or cloth to define **areas**.



For more info, check out...

◀ 2018 book available at Springer.com and Amazon.com

NCSU GeoForAll: geospatial.ncsu.edu/geoforall

▶ with links to YouTube videos, GitHub repositories, and more

TANGIBLE LANDSCAPE

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NC STATE UNIVERSITY

Center for **Geospatial** Analytics

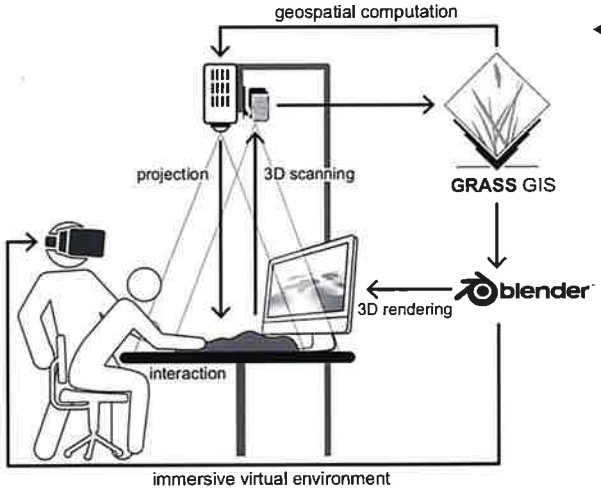
VIRTUAL REALITY + TANGIBLE LANDSCAPE

Coupling Tangible Landscape and Immersive Virtual Environments leverages the use of natural interactions with Tangible User Interfaces (TUI) and realistic representations of landscapes offered by Immersive Virtual Environments (IVE).

Researchers can reshape the physical model of a landscape by hand, create patches of trees, define viewpoints, or draw a route for a walk-through on the Tangible Landscape and—in near real time—see both a 3D augmented geospatial simulation projected on the tangible model and realistic renderings of human-scale views rendered on a computer display and in virtual reality head-mounted displays, creating an immersive experience.

Research Team

Dr. Payam Tabrizian, Dr. Anna Petrasova, Dr. Vaclav Petras, Garrett Millar, Dr. Brendan Harmon, Dr. Helena Mitasova



How It Works

As a user interacts with Tangible Landscape, Blender (an open source 3D modeling and rendering software) is coupled with GRASS GIS to continuously update the location, size, pattern, and texture of a geo-referenced 3D model, as well as camera position and viewing direction.

For more info, check out...

2017 ACADIA conference paper, "Tangible Immersion for Ecological Design," available through ResearchGate

NCSU GeoForAll: geospatial.ncsu.edu/geoforall

with links to YouTube videos, GitHub repositories, and more

TANGIBLE LANDSCAPE

blender

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GRASS GIS

OSGeo Project

Bringing advanced geospatial technologies to the world

A mature spatial analysis suite

GRASS GIS is powerful free and open source software for performing spatial analysis. It consists of more than 500 modules (plus hundreds of user add-ons that can extend its functionality) for processing vector, raster, voxel and temporal data.

Many interfaces to other programs in related domains like geostatistics, databases, web map services and even other GIS software exist. It can serve as a desktop GIS, with a modern graphical user interface, as well as the backbone of a GIS infrastructure. **GRASS GIS** is used in scientific applications, commercial settings and by public authorities all over the world.

A long term endeavor

GRASS GIS was born more than 30 years ago... and the latest commit is probably just few hours old! Many people have contributed to improve the software. Its strength and success rely on an active development team and the feedback of a wide contributor community; both combine their efforts to make GRASS GIS easier, more useful and powerful to everybody.

Features

- GRASS GIS supports nearly all common GIS file formats through the use of the GDAL/OGR library
- **Raster analysis:** map algebra, interpolation, mask, correlation/covariance analysis...
- **3D raster (voxel) analysis:** 3D map algebra, 3D interpolation, 3D visualization...
- **Image processing:** aerial/UAV image, satellite data, supervised/unsupervised/object classification...
- **DTM analysis:** contour/surface generation, cost-path slope-aspect analysis, hydrology
- **Vector analysis:** buffer, overlays, network analysis...
- **Temporal (4D) framework:** support for time series big spatio-temporal environmental data
- **Point cloud analysis:** LiDAR, interpolation...
- **Spatial statistics:** correlation/covariance analysis, regression..
- **Geocoding:** raster and vector maps
- **SQL-support:** database interfaces

Interfaces

GRASS GIS can be used through different interfaces:

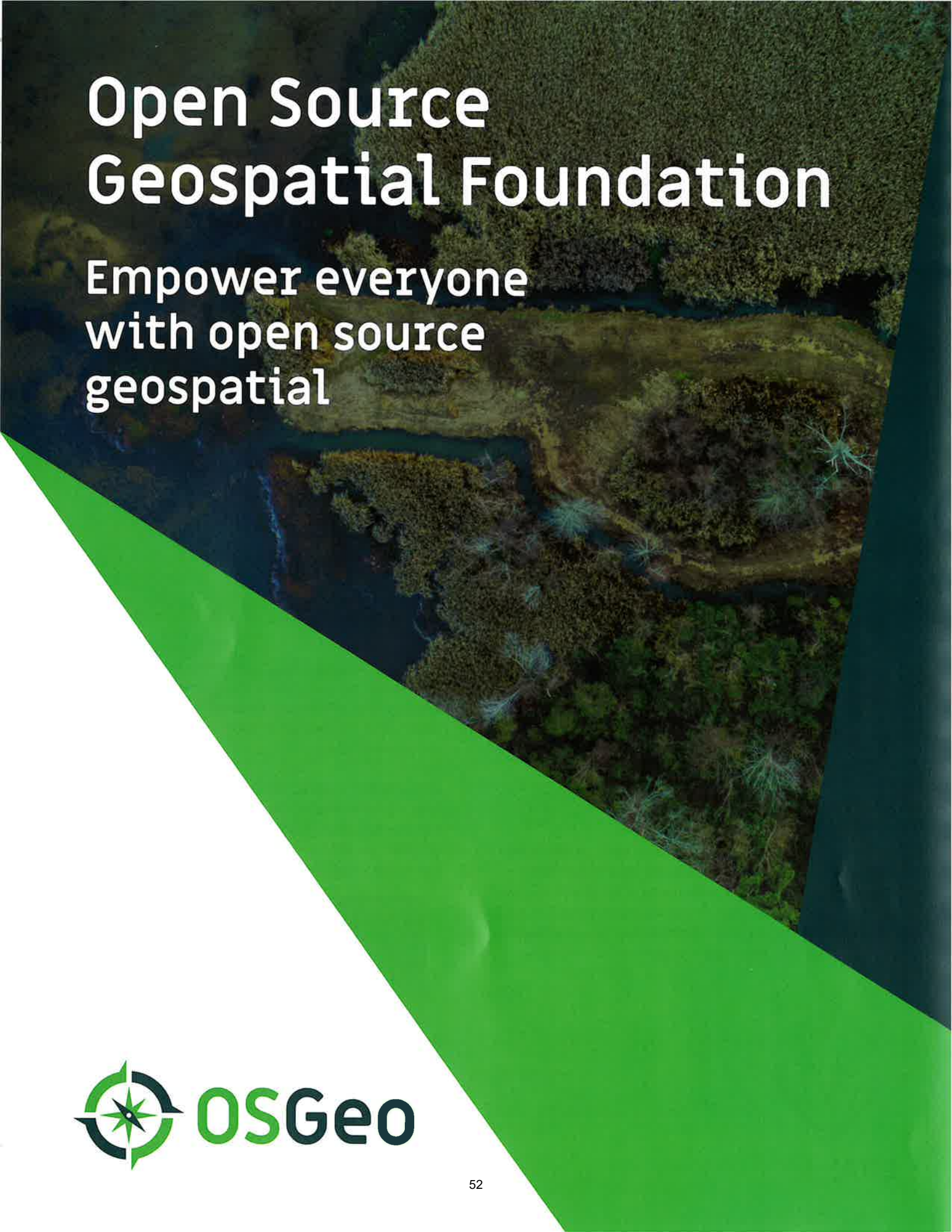
- the simplest for new users is the Graphical User
- Interface (GUI) with several powerful tools
- power users use the text-based command line interface (CLI)
- C API
- for the Python language there is a scripting library and an object-oriented Python API
- web interface through WPS servers
- QGIS has two different ways to run GRASS GIS modules
- R also has an interface to GRAS GIS, called rgrass7

GRASS GIS

grass.osgeo.org

Open Source Geospatial Foundation

Empower everyone with open source geospatial



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NC STATE EXTENSION

2021 Plant Disease and Insect Clinic Year in Review

Find this article at:
go.ncsu.edu/readext?847303

— Written By Matt Bertone

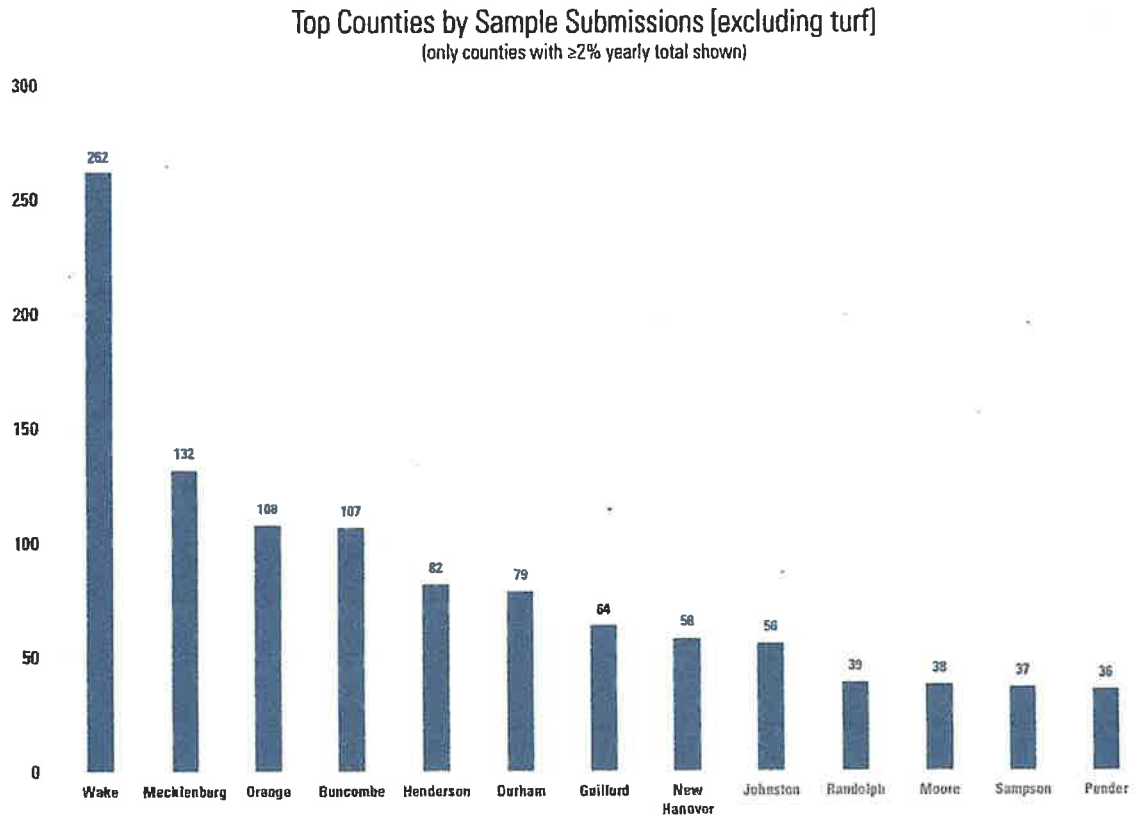
en Español

Last year (2021) was a busy one for us at the Plant Disease and Insect Clinic (PDIC). It was also eventful: all lab members returned to full-time work in the clinic around July (following approved COVID safety guidelines) and we welcomed a new, full-time pathologist, Dr. Swarna Moparthi!

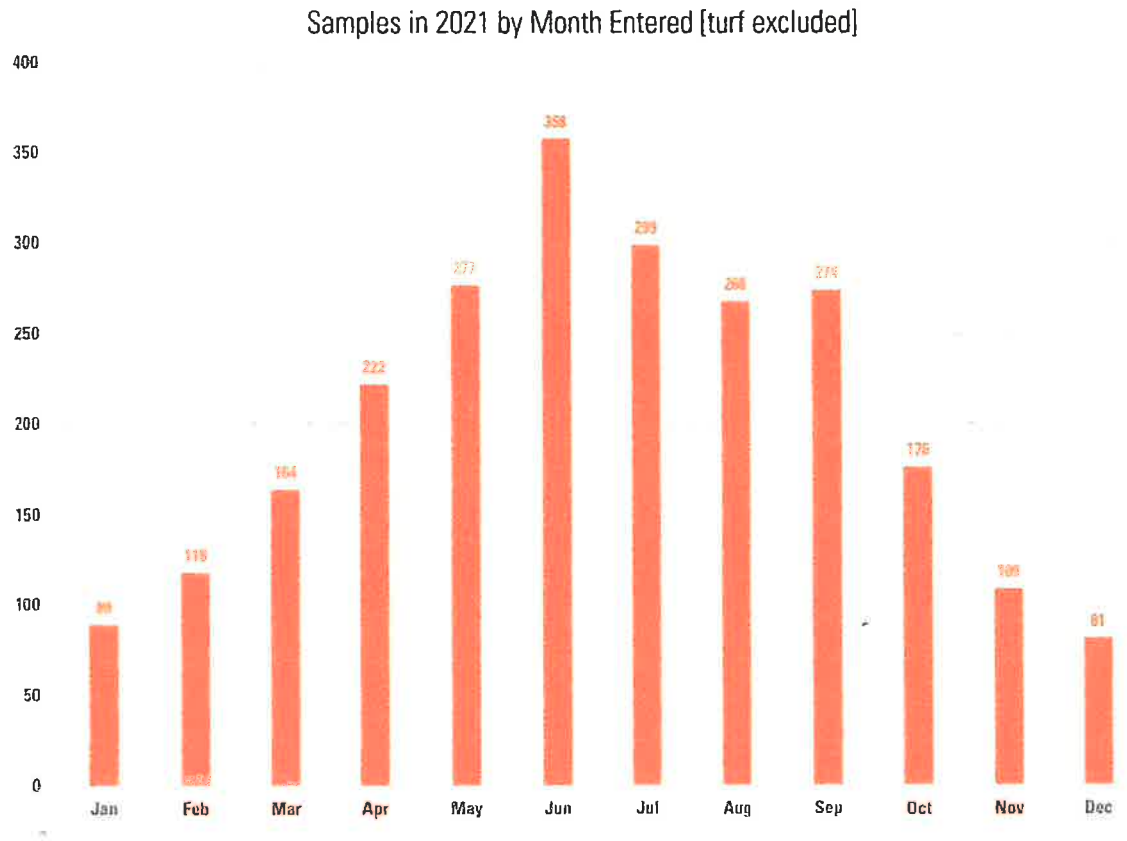
In total, the Plant Disease and Insect Clinic and Turf Diagnostic Lab **received 2,820 samples last year**. Below are summaries of samples we received in 2021 and results coming from these samples, including the some of the pests and pathogens we've identified. *Note that most of these summaries do not include turf samples. For a summary of 2021 from the NC State Turf Diagnostic Lab, please see their annual review.*

Samples:

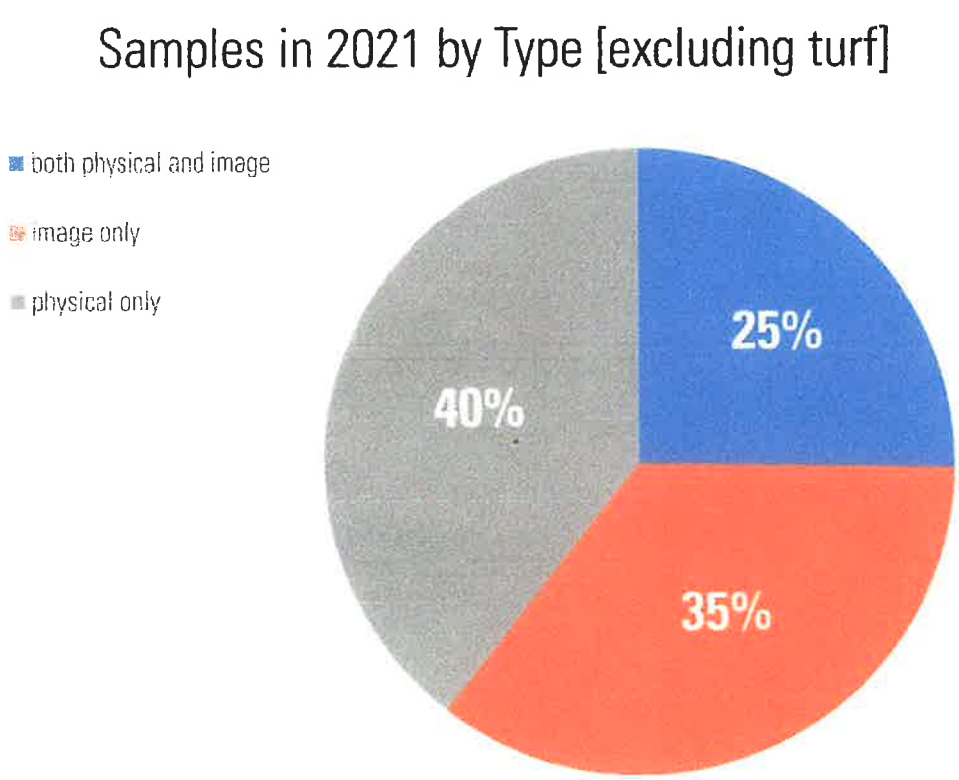
The PDIC processed 2,435 samples. Ninety-eight percent (98%; 2,388) of the samples we received in the PDIC came from within North Carolina and every county (n=100) in the state submitted at least one sample in 2021. Numerous counties submitted multiple samples throughout the year, with Wake county submitting the most (262). Here are counties that submitted the most samples:



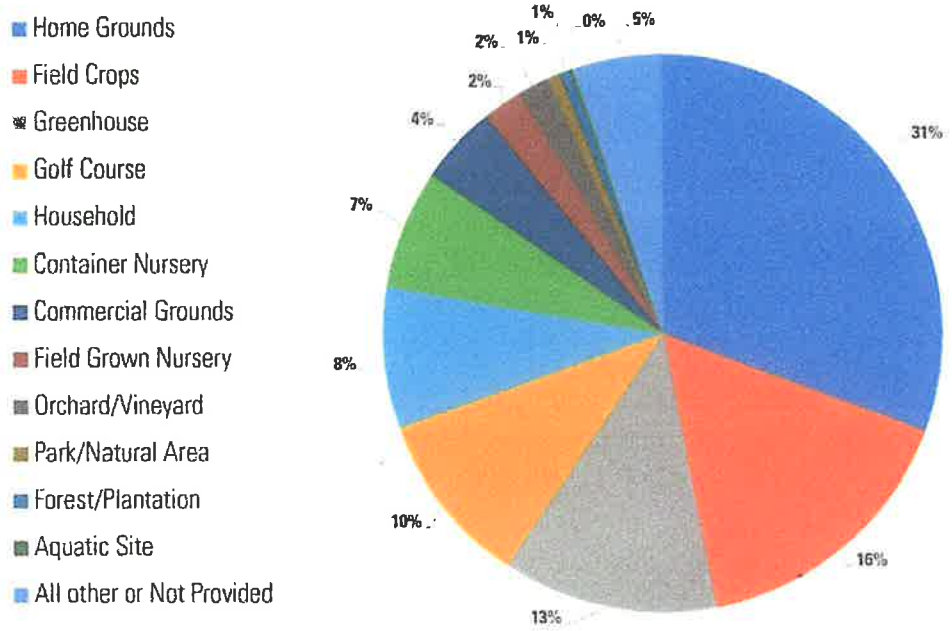
Not surprisingly, samples were submitted most often in the summer, during the growing season and while folks were out and about in their yards. June saw the most samples submitted, with 358 or over 10 per day!



Samples can consist of images only, physical samples only, or a combination of both. In 2021, most samples were physical (40%), closely followed by image samples (35%), then a combination of both (25%).

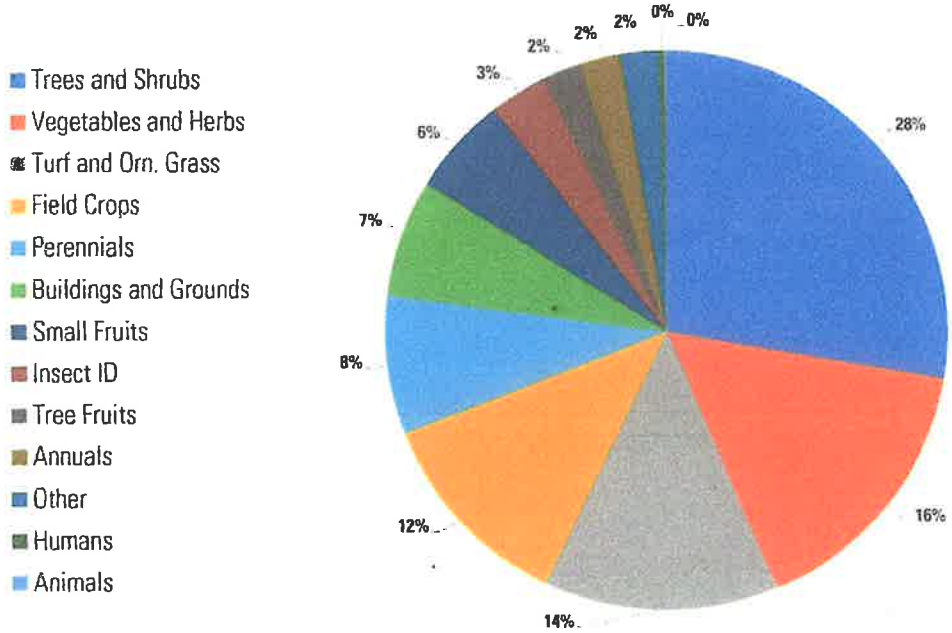


Samples in 2021 by Host Site Type (turf included)

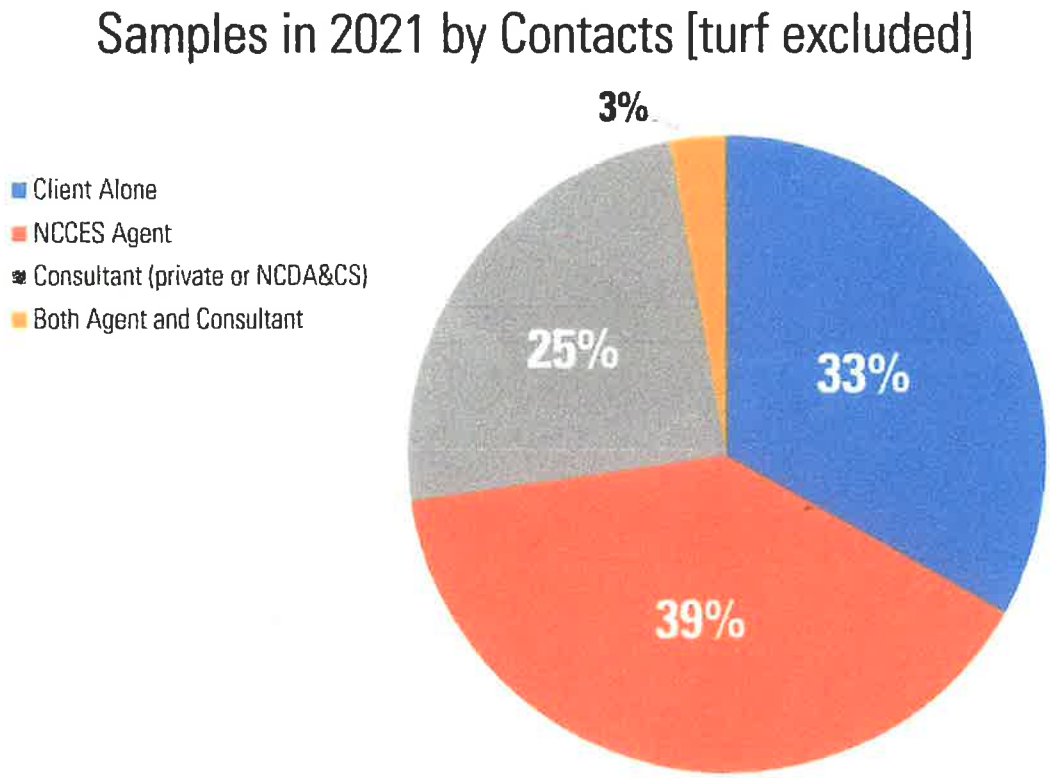


The most common types of hosts submitted were trees and shrubs (28%), followed by vegetables and herbs (16%), turf and ornamental grasses (14%), field crops (12%), and perennial plants (8%).

Samples in 2021 by Host Category (turf included)



These samples were submitted by different types of clients. Although direct submissions by clients made up 33% of all submissions, the remaining samples were submitted by state agricultural extension agents, various consultants, or a combination of them.



The top 40 "hosts" submitted to the clinic can be seen below. In addition to these common hosts, we received 124 host genera that were represented by only a single sample in 2021.

Host	# Samples
Tomato	151
Dwelling	134
Cucurbits (e.g. watermelon, squash, cucumber)	128
Tobacco	100
Insect ID	88
Boxwood	81
Strawberry	81
Soybean	81
Oaks	54
Home & Garden	50
Kale crops	46
Arborvitae	46
Sweetpotato	41
Maples	40
Azalea and Rhododendron	40
Holly	36
Cherry, plum, & peach (ornamental and for fruit)	34
Dogwood	33
Pepper	31
Corn	31

Host	# Samples
Blackberry and raspberry	30
Juniper	27
Apple/crabapple	24
Wheat	24
Leyland cypress	24
Rose	23
Grape	22
Blueberry	22
Industrial hemp	20
Magnolia	20
No site specified	19
Fraser fir	17
Chrysanthemum	17
Fungus ID request	17
Crape Myrtle	17
Redbud	15
Hydrangea	13
Pine	13
Pecan	12
Buddleia	12