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YouTube

The Chernobyl of the East: Aral Sea Disaster

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CaspianReport
Published on Jul 10, 2019

The Aral Sea is shrinking rapidly. What remains in place is another Chernobyl with a geopolitical fallout that is yet to come.

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BAKU - By the Uzbek-Kazakh border sits a body of sand that is filled with mounds of seashells and dozens of rusty abandoned fishing vessels. They serve as remnant relics of the once bountiful Aral Sea. Up until the 1960s, the Aral was the world's fourth-largest inland body of water, with many unique species animals and thriving villages. All that has ceased to exist, and what remains in place is another Chernobyl with a geopolitical fallout that is yet to come.

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✔ Bitcoin Cash ▶ 1BKLti4Wq4EK9fsBnYWC91caK7NZfUhNw9

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CaspianReport 2 weeks ago (edited)

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30

Ouzy 360 2 weeks ago

The reason why I like this channel is because you actually tackle geopolitics, not just focusing on the sa
it up.

638

Aussie Boy 2 weeks ago

This event almost never get talked about. Very underrated. Thank you for covering.

423

Kim Jong-un 2 weeks ago

The Soviets also caused a crater to continuously burn for decades in Turkmenistan. It's called the Gate

386

Goyon Man 2 weeks ago (edited)

4:07

"Most of the Soviet leadership who made these decisions are not around to witness the fruits of their la

218

bjsmith503 2 weeks ago

My old political science teacher, (a retired Lt. Colonel) back in 1998 said that future wars would most lik
rights. I'm starting to see why he thought that.

139

Асанали Кудайбергенов 2 weeks ago

Please, do geopolitics of Kazakhstan

88

Arthur Lecomte 2 weeks ago

You should do one about the Euphrates and the Tigris drying up and the geopolitical consequences

49

Archangelm127 2 weeks ago

I'd heard about the Aral Sea disaster before this. As I recall, the original Soviet plan included diverting a
something to replenish the Aral Sea. That replenishment plan was scrapped, but they went ahead with tl
anyway. Go figure.

137

M L 2 weeks ago

The Soviets also tested most of their nukes in Kazakhstan.

69

Michael Henman 2 weeks ago

I like how you actually explained the Soviet decision to grow cotton, this is too often presented as a stup
whim, but there was obviously an economic need for it.

55

i HughmannTM 2 weeks ago (edited)

i don't get to thank Caspian report but I'm early now so
I thank Caspian report from bottom of my heart

78

Haven Skye 2 weeks ago

Most Americans will simply dismiss this a Soviet (Communist / Socialist) problem... But we see the exa
happening in the US. Agricultural and urban / suburban development in Florida has choked the Everglad
The development of the central California agricultural area has guzzled water from delicate ecosystems
regions in neighboring states. Nuclear waste sits in "temporary" storage areas because our politicians a

245

Diego Natan 2 weeks ago

TBH Aral is worse than Chernobyl. at least in Chernobyl the wildlife is thriving.

28

daddyleon 2 weeks ago

Shirvan: "Aral Sea"
YouTube: "he probably means 'RLC', must've made a mistake in the title",

30

Sara Wilcker 2 weeks ago

How come no one ever teaches this in school? I've never even heard of this before.

69

Carl Ewen-Lewis 1 week ago

Forced labor and the cotton industry, where have I heard this before......

14

Greg Leonard 3 days ago

Much respect for use of the language with clinical and educated precision; (very appealing, despite the and) whatever your mother-tongue is. Well done.

3

Henri Mourant 2 weeks ago

I would say it's worse then Chernobyl in terms of the environment. Chernobyl today is basically a nature

13

Jasc Random 2 weeks ago

I've heard about the Aral sea disaster, but didn't know it was this bad.

13

TORSDAG 25. JULI 2019

Tidsskriftet
DEN NORSKE LEGEFORENING

The vanishing Aral Sea: health consequences of an environmental disaster

GLOBAL HELSE | KLINISK FARMAKOLOGI / SAMFUNNSMEDISIN

Turid Austin Wæhler, Erik Sveberg Dietrichs About the authors

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ARTICLE REFERENCES COMMENTS (0)

Access to safe water and food is linked to global, regional and local climate changes. In some areas swift changes have entailed serious health-related consequences. An alarming example is found in the Aral Sea area of Central Asia.

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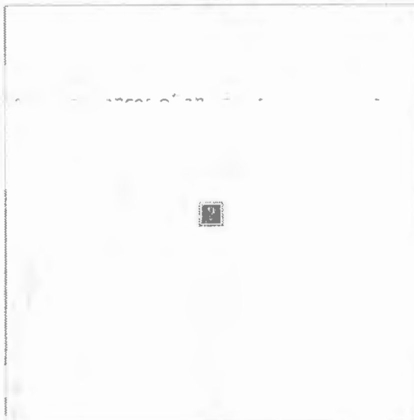

A comparison of the Aral Sea in 1989 (left) and 2014 (right). Photo: NASA

The Aral Sea area, located on the border between Kazakhstan and Uzbekistan, was once the fourth largest inland sea in the world. Since the 1960s, water volume has been reduced by a factor of fourteen (1). Tributary water to the Aral Sea derives from the rivers Amu Darya originating in Tajikistan, and Syr Darya originating in Kyrgyzstan. Early in the 20th century demand for river water to supply local agriculture, primarily the cotton industry, led to construction of irrigation systems (2). A highly inefficient system for water allocation combined with excessive resource exploration was the result. Subsequent failure to maintain infrastructure, in tandem with large emissions of pollutants have had serious consequences for people inhabiting the areas around the Aral Sea.

After the Soviet Union created collective farms in 1929, water usage increased and the Aral Sea started shrinking. By 1987, the lake had split into two separate parts (3). Water distribution was complicated by the collapse of the Soviet Union in 1991, creating several new countries with separate water policies (4). Uzbekistan is today one of the world's largest cotton producers and needs large amounts of water to sustain production (5). A simultaneous population increase complicates the severe water shortage in the area (6) and contributes to the environmental disaster, evident by the disappearance of the Aral Sea. Its role as an important food source is impaired due to increased salinity. In 1983 more than 20 different fish species were declared extinct (7). River deltas have been replaced by desert, mediating a replacement of the original flora with hardier plants (3). Local climate change has occurred simultaneously with the disappearance of water. Formerly hot, humid regions are acquiring a cold, dry desert climate (8).

Pollution

No rivers flow out of the Aral Sea; water disappears through evaporation. Before construction of the excessive irrigation systems, water level was kept stable by inflow from Amu Darya and Syr Darya. As human use of river water has increased, the composition of lake water has changed. Salt concentration has increased tenfold (9) and local groundwater has a salt concentration reaching 6 g/L. This is six times higher than the concentration considered safe by WHO. Naturally, local inhabitants are exposed to saline water (7) and in 2000 only 32 % had access to safe drinking water (10). An increased frequency of storms carries 43 million tons of dust and sand from the dried-out sea floor through the air yearly (11, 12). Accordingly, the rate of dust deposition is among the highest in the world (12) and contains large amounts of salts and pesticides, probably related to the water quality in the tributary rivers. Fertilisers, chlorinated organic pesticides and other chemicals are used in large quantities for agricultural purposes and pollutant-rich water returns to the rivers that supply the Aral Sea (13). Pollution also originates from the extensive mining industry in the area. Drain water contains heavy metals which flow into the rivers (14). In Amu Darya, concentrations of copper, nickel and lead all exceed WHO recommendations (14).

Aral Sea concentrations of the pesticides dichlorodiphenyldichloroethylene (DDE) and dichlorodiphenyltrichloroethane (DDT) do not exceed WHO recommendations (15). It is, however, apparent that both water (14) and soil (12) in the region are affected by toxic pollutants from industry and agriculture. The concentration of dioxin and dioxin-like compounds (polychlorinated biphenyl (PCB), polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs)) has been found in fish, sheep, milk, eggs and several other foods. Carrots and onions, important in the local diet, have been shown to contain high amounts of chlorinated organic pesticides. High levels of hexachlorocyclohexane (HCH) have been found in most samples (16).

Human samples reflect the high amount of pollutants in water and food.

DDE blood levels, for example, are higher than in Russian Arctic settlements (17). A lifelong exposure is evident. Blood samples from pregnant women and umbilical cords show high amounts of DDE, also found in breast milk (18). DDT levels in breast milk from Aralsk have been proven to be higher than in the rest of Kazakhstan (19). Although plasma concentrations of perfluoroalkyl substances (PFASs), which are used in products for their fat and water-resistant abilities, have been shown to be lower than in Arctic Russia (20), school-aged children in Aralsk have high blood levels of DDE and DDT compared to other parts of Kazakhstan and two European countries (21, 22).

Health-related consequences

Living in the Aral Sea area has detrimental consequences for fertility, both in people growing up in the area and for adult immigrants (23, 24). Furthermore, in the late 1990s infant mortality was between 60 – 110/1000, a figure far higher than in Uzbekistan (48/1000) and Russia (24/1000) (25). At the same time, body mass index (BMI) was inversely correlated with blood concentration of PCBs, DDTs and DDEs in children between 7 and 17 years, advocated as an effect of malabsorption.

Values of insulin-like growth factor type 1 (IGF-1) tended to correlate with a reduction in body mass index (26). It is known that low IGF-1 values may be associated with high concentrations of DDT or DDT metabolites in the body (27).

In the late 1990s, Kazakh children believed to be harmed by Aral Sea pollution were sent to a rehabilitation centre in Almaty. Clinical findings included skin lesions, heart and kidney disease. Growth retardation and late sexual maturation were common (28). Further, anaemia was related to settlement near the lake (29) and local children had impaired renal tubular function. Chronic heavy-metal exposure has been shown to cause such damage, and polluted water could be causative (30). Hypercalciuria in children (31) could possibly be related to intake of saline-rich water, food and dust, or renal tubular dysfunction, associated with toxic damage after exposure to substances such as lead and cadmium (29).

Studies conducted in 2000 examined the respiratory function of local children. In an area within 200 kilometres of the Aral Sea, schoolchildren had low vital capacity and a high cough rate (32). Surprisingly, dust exposure appeared unrelated to the prevalence of asthma (33). Therefore, it is still uncertain whether the environmental disaster has had a direct impact on the frequency of respiratory disease (29).

Compared with far eastern Kazakhstan, the Aral Sea population seems more prone to develop cancer (34, 35). During the 1980s, the occurrence of liver cancer doubled (36), while the incidence of oesophageal, lung and stomach cancer appear highest (37). Inhabitants of the Uzbek part of the Aral Sea area subjectively experience their own health as poor, correlating with concerns about the environmental disaster. A large percentage of residents wish to emigrate (25, 38).

Water access

With the disappearance of rivers flowing into the Aral Sea area, drinking water is a highly valuable resource. Water shortage and contamination of stored drinking water are important causes of faecal-oral transmission of disease in Aral Sea area households (39). Accordingly, hepatitis A (11) and diarrhoeal disease are frequently reported. At the turn of the century, the infant death rate due to diarrhoea was twice that of bordering areas (10). Parasitic infections and tuberculosis are also a challenge (28). Some claim that the high incidence of disease, including tuberculosis, is related to increased poverty, resulting in poorer personal hygiene and malnutrition (40). Indeed, multi-drug resistant tuberculosis presents a significant challenge in this region (29, 41).

Inadequate sanitation and water access represent a considerable risk for diarrhoeal disease, one of the main global contributors to child mortality, causing one in ten child deaths (42). In total more than 600 million people lack improved drinking water (43). Although access to safe water is increasing, environmental disasters such as those affecting the Aral Sea, and unexpected effects of climate change might impede this development. In May 2007, a massive bloom of the toxin-producing cyanobacteria *Microcystis* occurred in China's third largest freshwater lake, Taihu. This crisis, attributed to an unusually warm spring, left approximately two million people without drinking water for a week (44). More predictable effects of climate change will also affect freshwater access. Models predicting global warming show that it will occur more rapidly at high altitudes (45), thus affecting communities relying on mountain glaciers for their water supply. Big cities such as Quito and La

Paz in South America partly depend on water from glaciers, some of which are rapidly retreating (45). The Aral Sea area is also at risk. Both Amu Darya and Syr Darya are provided with glacial water from the Pamir and Tian Shan Mountains, respectively. The melting glaciers and Arctic ice-cap (46) entail equally disturbing challenges for small island nations, such as Kiribati, that risk being flooded (47).

An alarming signal

As we have seen, global, regional and local climate change can have negative consequences for human health. The Aral Sea disaster shows the result of short-sighted human exploitation of nature and is an alarming signal, indicating that all human activities with potential climate effects must be carefully thought through.

This article is part of the series 'Global Health in the Era of Agenda 2030', a collaboration between Norad, the Centre for Global Health at the University of Oslo and The Journal of the Norwegian Medical Association. Articles are published in English only. The views and opinions expressed in the articles are those of the authors only.

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Public health problems in the Aral Sea region

After irrigation projects diverted water from the Aral Sea it began to dry up and left behind salts, other minerals and toxins in the soil. These not only contaminated the soil but also were picked up by winds and storms, and traveled to other areas, including over crop lands. This has led to increased health problems like respiratory diseases and cancers, among others. The change in the size of the Aral has also affected the local climate and resulted in increased occurrence and worsening of storms.[1]

Contents

Background

There is no doubt that the shrinking of the Aral Sea has resulted in health problems for the local community. However, there is debate as to what extent of these problems can be sourced to this environmental situation. The full effects could take a generation to fully materialize and patterns of health problems to show up. Some of the main reasons why the Aral sea area suffered greatly were from "over irrigation and water mismanagement." Environmental impacts resulting from the changes in the Aral Sea region that could affect human health are "the salinization of the water table, pesticides in the environment and food chain, dust storms and air quality."[2]

In the Uzbek region years of monoculture agriculture of cotton fields left soils depleted of naturally occurring minerals and nutrients. This eventually led to an increased use of pesticides and fertilizers to try and counter these new soil deficiencies. However, these increased chemicals found their way into the soils, water, and finally the Aral sea.[3] These types of agricultural activities have also "resulted in widespread soil erosion, chemical pollution, and poor water quality and quantity." [4]

Effects on Infant Mortality Rates

the sea dries up the contaminants become exposed on the surface and enter into the soil while also being blown into the air. These environmental impacts have had wide-ranging effects on health of local residents. Increases in the occurrence of many diseases and conditions have been noted and linked to the shrinking of the Aral. Facing the highest risk from exposure to contaminants and toxins are infants and children. This has contributed to an increasing infant mortality rate in the area. According to Newbold the infant mortality rate is defined as "the number of deaths of infants younger than one year of age per one thousand births." [5]

Infant mortality rates have been increasing in this region since the 1970s, while elsewhere in the world they have generally been going down.[6] For residents of the Aral sea region living there has led to high "exposure to industrial pollutants such as polychlorinated biphenyl (PCB) compounds and heavy metals but also to pesticides."[7] This phenomenon leading to increased infant mortality rates has been reported as high as 70 in Kazakhstan as of 1993.[7] Toxins can come from all sources including breathing them in from the air, drinking water, and food. However, a young baby does not have much choice about what to eat or drink. It has been found that these contaminants can be passed down through breast feeding and "in a number of areas the physicians recommend against breast feeding babies, as the nursing mothers milk is toxic." [3]

As seen in Table 1, other surrounding countries and areas have also experienced an increase in infant mortality rates. Although there are many other factors that contribute to infant mortality rates, the environmental state in the area has a definite influence on increasing rates. When compared with developed countries these rates can illustrate differences in health care and access to health care between the areas.

Table 1: Infant Mortality Rates, 1985 -2008[8]

	1985-1990	1990-1995	1995-2000	2004	2008
Afghanistan	170	160	152	165	163
Kazakhstan	36	35	35	52	29
Kyrgyzstan	45	40	40	42	50
Turkmenistan	58	55	55	74	74
Uzbekistan	53	44	44	62	48
Tajikistan	58	57	57	50	65
United Kingdom				5.3	4.9
Canada				5.2	5.4
USA				6.7	6.6

List of Adverse Health Effects

In Turkmenistan alone, 50% of all reported illnesses in children are related to respiratory system difficulties.[9] The effects of this situation are far reaching and affect people in a wide range of ailments. Following is a list of health problems contributing to high infant mortality, death, and lower standard of living in the Aral Sea area:

- diarrheal diseases
- vaccine preventable diseases such as tuberculosis
- nutritional deficiencies
- upper respiratory tract infections[7]
- teratogenesis

- endocrine disruption
- neurodevelopmental effects
- behavioral effects[2]
- gastro-enteritis[3]
- typhoid fever
- hepatitis
- esophageal cancer
- various other cancers
- hypertension
- heart disease
- anemia
- kidney disease[2]
- eye disease

Solutions

A large concern of remediation of the area is the reduction of the blowing salt and minerals from the exposed sea bed. Some solutions include constructing dikes to control water flows and restricting the water amounts diverted for irrigation. However, the health effects have already been felt and will continue to be present for a long time even if the situation is turned around in the very near future.[1]

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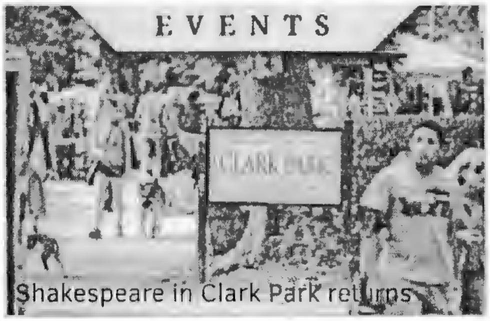

MARCH 29, 2019

Gardeners, beware: there's dangerous bacteria lurking in potting soil

Here's a few diseases and symptoms to keep a watch on

BY **BAILEY KING**
PhillyVoice Staff

MARKUS SPISKE/UNSPLASH

If tackling your garden (or potted plant situation) is on your agenda for this mild weekend, there's something you should know: potting mix is known to carry harmful bacteria and fungi that have sparked serious lung infections – and even death, in some cases.

Infection-causing bacteria and fungi live in soil and water, so it's not surprising that they can be present in potting mix and threaten people's health. Of course, overall, the risk is very low.

Potting mix is usually a mixture of inorganic and organic material, according to Peter Collignon, professor of infectious diseases and microbiology at Australian National University:

> *It often rests at a higher temperature than soil because of where and how it's stored, so it retains heat for longer. Bacteria and fungi generally grow better in moist and warm environments.*

RELATED READ: Experts think we should drop the 'antibacterial' outlook on life

> *If bacteria or fungi are already present in low numbers, they can quickly grow to very high numbers in optimal conditions. This includes many bacteria in soil that can cause problems in people — such as strains of nocardia (causes nocardiosis, an infection of the lungs or whole body), legionella (causes Legionnaires' disease), and clostridium (causes tetanus).*

According to Fine Gardening, senior gardeners and gardeners with compromised immunity are at highest risk of contracting a disease.

According to Mark Blaskovich, senior research officer at The University of Queensland:

> *Bacteria such as Escherichia coli, Salmonella, Campylobacter jejuni, and Listeria monocytogenes are often present in gardens as a result of using fertilizer consisting of cow, horse, chicken or other animal manure. Bacterial infections can lead to sepsis, where the bacteria enter the blood and rapidly grow, causing the body to respond with an inflammatory response that causes septic shock, organ failure, and, if not treated quickly enough, death.*

Legionnaires' disease is a form of pneumonia most commonly caused by the bacterium Legionella pneumophila, which is found in lakes, streams and other freshwater terrains. The first recognized cases of the disease occurred in 1976 in Philadelphia during an American Legion convention at the Bellevue-Stratford Hotel in Center City. More than 180 attendees came down with the disease and 29 of them died, according to the Centers for Disease Control and Prevention.

A lesser known cause of Legionnaire's disease, the Legionella longbeachae bacterium, was first isolated in 1980 from a patient in Long Beach, California. The bacteria is found in compost and potting soil, Medical News Today reports.

Bacteria or fungi need to be introduced to the body in order to cause disease. This usually happens by inhaling the organisms into the lungs. It can also occur through the skin, such as with the chronic fungal infection sporotrichosis, also known as "rose gardener's disease."

While the risk is low, if people do develop symptoms that are ongoing and have had recent exposure to potting mix within the incubation period (two to 10 days after exposure), they need to seek medical help and make it clear they are worried that potting mix may be a cause.

It is especially important to disclose the potting mix connection to providers because the antibiotics needed to kill legionella are different than the standard penicillin-like antibiotics used to treat pneumonia acquired in the community.

As gardening season picks up, fairly simple precautions such as washing hands, wearing gloves and — when necessary — wearing a mask will ensure rates of infection remain low.

BAILEY KING
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- Urinary tract infections can trigger stroke in patients, new study finds

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- ◯ Yes, I've seen the footage
- ◯ No, I haven't seen it
- ◯ Does not apply / Other

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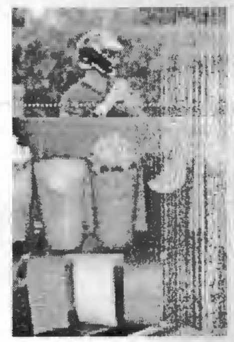

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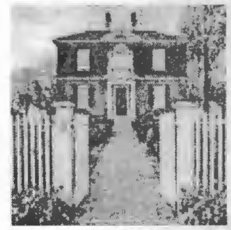

FLORIDA DEPARTMENT OF
ENVIRONMENTAL PROTECTION

ERP Dredging and Filling

What is Dredge and Fill?

Dredging means excavation in wetlands or other surface waters or excavation in uplands that creates wetlands or other surface waters. Filling means deposition of any material (such as sand, dock pilings or seawalls) in wetlands or other surface waters.

The surface waters regulated under the dredge and fill program include bays, bayous, sounds, estuaries, lagoons, rivers, streams, the Gulf of Mexico, the Atlantic Ocean, most natural lakes, and all waters and wetlands (natural or artificial).

Why are dredge and fill activities regulated?

Dredging and filling in the surface waters of Florida has been regulated since the early 1970s. This program was established under Chapter 403, F.S., to protect our surface waters from degradation caused by the loss of wetlands and from pollution caused by construction activities.

Alteration of wetlands and other surface waters may have a detrimental impact on the environment. That impact could extend beyond the limits of the work site, affecting other public or private property. Polluted waters can be conveyed off-site through connecting waterbodies. The elimination or degradation of wetlands will cause a reduction of beneficial functions provided by the wetlands.

Wetlands provide a number of important and beneficial functions. During periods of heavy rainfall, wetlands serve as flood storage areas, where water can spread out without damage to developed uplands. As the water passes through the wetlands, pollutants are filtered out. Wetlands also stabilize shorelines, thereby preventing the harmful effects of erosion. Wetlands produce the basic food material used by many fish and other aquatic life. Some wetlands also serve as nursery grounds for fish and rookery areas for birds. Many wildlife species, some of which are threatened or endangered, need to live in wetlands for all or part of their life.

Filling wetlands can increase on-site and off-site flooding. Dredging and filling also can degrade the quality of water during and after construction, and can reduce the populations of fish and wildlife. In fact, it has been estimated that as much as 80 percent of our recreationally and commercially important fish species are dependent upon wetlands for at least some portion of their life cycle.

How is dredging and filling regulated?

Any activity on or over wetlands and other surface waters (dredging and filling) is regulated by the department and five water management districts (Northwest Florida, Suwannee River, St. Johns River, Southwest Florida and South Florida) through the Environmental Resources Permitting program. Dredging and filling also is regulated by the federal government under a separate program administered by the U.S. Army Corps of Engineers. The process is initiated by submitting a joint (interagency) application to the department or to one of the above water management districts. The appropriate agency is determined by a division of responsibilities specified in Operating Agreements between the agencies. Upon receipt of the application by the department or district, a copy also is forwarded to the Corps to initiate the federal permitting process.

Streamlining

The state phased out the dredge and fill permit program by combining it with the management and storage of surface water (MSSW) permit program of the districts, creating a new environmental resource permit (ERP) program under Part IV of Chapter 373 of the Florida Statutes. The dredge and fill program described above will remain in place only within the limits of the Northwest Florida Water Management District (NWFWMD) for permitted activities or applications deemed complete before November 1, 2010, and for certain grandfathered activities in the rest of the state. The ERP program is in effect throughout the state. The ERP program regulates dredging and filling in all wetlands and other surface waters, and also regulates the aspects of the MSSW program such as water quantity (flooding) and water quality (stormwater) in both wetlands and uplands.

Sovereign Submerged Land Approvals and the ERP Program

In addition to the regulatory (permit) program discussed above, permission to use any sovereign (state-owned) submerged lands also must be addressed in the review process. For activities located on sovereign submerged lands, the application to use these areas (known as the proprietary authorization) will be reviewed in conjunction with the regulatory application. Both forms of authorization will be requested in the same application, and will be reviewed and granted or denied at the same time. This linkage will streamline the review of the state regulatory and proprietary authorizations statewide for both the department and the WMDs, except within the NWFWMD.

Future Permit Streamlining Initiatives

To further streamline the above programs, the department and the WMDs are developing rules to allow us to delegate the ERP program to qualified local governments. All regulatory authorizations under the ERP program, as well as any additional local permits, will be granted or denied at the same time by the local government once they are granted delegation. The department and WMDs are also working with the Corps to reduce overlap in state and federal regulatory permits. Until the local and federal programs are fully linked with the WR and ERP programs described above, applicants are advised to work with, and obtain all needed authorizations from, all of these agencies prior to dredging and filling in wetlands or other surface waters.

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Aral Sea

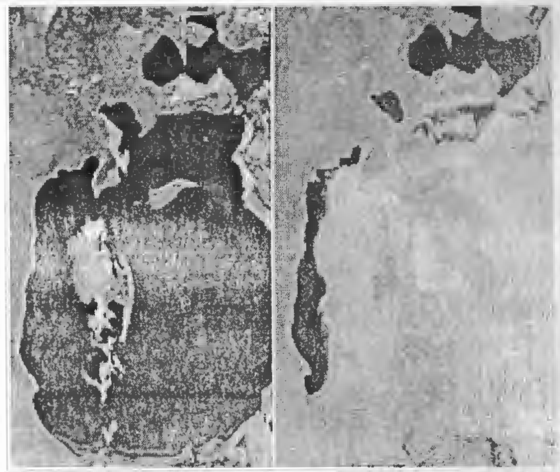
The **Aral Sea** (/ˈærəl/)[4] was an endorheic lake lying between Kazakhstan (Aktobe and Kyzylorda Regions) in the north and Uzbekistan (Karakalpakstan autonomous region) in the south. The name roughly translates as "Sea of Islands", referring to over 1,100 islands that had dotted its waters; in the Turkic languages *aral* means "island, archipelago". The Aral Sea drainage basin encompasses Uzbekistan and parts of Tajikistan, Turkmenistan, Kyrgyzstan, Kazakhstan, Afghanistan and Iran.[1]

Formerly the fourth largest lake in the world with an area of 68,000 km^2 (26,300 sq mi), the Aral Sea has been shrinking since the 1960s after the rivers that fed it were diverted by Soviet irrigation projects. By 1997, it had declined to 10% of its original size, splitting into four lakes: the North Aral Sea, the eastern and western basins of the once far larger South Aral Sea, and one smaller intermediate lake.[5] By 2009, the southeastern lake had disappeared and the southwestern lake had retreated to a thin strip at the western edge of the former southern sea; in subsequent years, occasional water flows have led to the southeastern lake sometimes being replenished to a small degree.[6] Satellite images taken by NASA in August 2014 revealed that for the first time in modern history the eastern basin of the Aral Sea had completely dried up.[7] The eastern basin is now called the Aralkum Desert.

In an ongoing effort in Kazakhstan to save and replenish the North Aral Sea, the Dike Kokaral dam project was completed in 2005; in 2008, the water level in this lake had risen by 12 m (39 ft) compared to 2003.[8] Salinity has dropped, and fish are again found in sufficient numbers for some fishing to be viable.[9] The maximum depth of the North Aral Sea is 42 m (138 ft) (as of 2008).[2]

The shrinking of the Aral Sea has been called "one of the planet's worst environmental disasters".[10][11] The region's once-prosperous fishing industry has been decimated, bringing unemployment and economic hardship. The water from the diverted Syr Darya river is used to irrigate about two million hectares (5,000,000 acres) of farmland in the Ferghana Valley.[12] The Aral Sea region is also heavily polluted, with consequential serious public health problems.

Aral Sea



The Aral Sea in 1989 (left) and 2014 (right)

Location	Kazakhstan - Uzbekistan, Central Asia
Coordinates	45°N 60°E
Type	endorheic, natural lake, reservoir (North)
Native name	**Aral teńizi** (Kazakh) *Orol dengizi* (Uzbek) Аральское море (Russian)
Primary inflows	North: Syr Darya South: groundwater only (previously the Amu Darya)
Catchment area	1,549,000 km^2 (598,100 sq mi)
Basin countries	Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, Russia, Afghanistan, Iran[1]

UNESCO added the historical documents concerning the development of the Aral Sea to its Memory of the World Register as a unique resource to study this "environmental tragedy".

Surface area	68,000 km^2 (26,300 sq mi) (1960, one lake) 28,687 km^2 (11,076 sq mi) (1998, two lakes) **17,160 km^2 (6,626 sq mi) (2004, four lakes)** North: 3,300 km^2 (1,270 sq mi) (2008) South: 3,500 km^2 (1,350 sq mi) (2005)
Average depth	North: 8.7 m (29 ft) (2014) South: 14–15 m (46–49 ft) (2005)
Max. depth	North: 42 m (138 ft) (2008)[2] 30 m (98 ft) (2003) South: 37–40 m (121–131 ft) (2005) 102 m (335 ft) (1989)
Water volume	North: 27 km^3 (6 cu mi) (2007)
Surface elevation	North: 42 m (138 ft) (2011) South: 29 m (95 ft) (2007) 53.4 m (175 ft) (1960)[3]
Settlements	Aral (Kazakhstan), Mo'ynoq, (Uzbekistan)

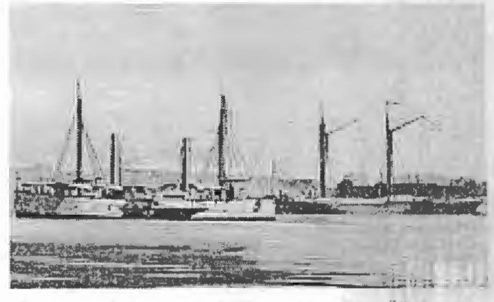
Contents

Formation

Geographer Nick Middleton believes that the Amu Darya did not flow into the shallow depression that now forms the Aral Sea until the beginning of the Holocene,[13] and it is known that the ...u Darya flowed into the Caspian Sea via the Uzboy channel until the Holocene.[13] The Syr Darya formed a large lake in the Kyzyl Kum during the Pliocene known as the Mynbulak depression.[14]

In the early 1960s,[17] the Soviet government decided the two rivers that fed the Aral Sea, the Amu Darya in the south and the Syr Darya in the east, would be diverted to irrigate the desert, in an attempt to grow rice, melons, cereals, and cotton.

This was part of the Soviet plan for cotton, or "white gold", to become a major export. This temporarily succeeded, and in 1988, Uzbekistan was the world's largest exporter of cotton.[18] Cotton production in Uzbekistan is still important to the national economy of the country.[19][20] Cotton is Uzbekistan's main cash crop, accounting for 17% of its exports in 2006.[21]



Ships of Imperial Russian Navy's Aral Flotilla in the 1850s

The construction of irrigation canals began on a large scale in the 1940s. Many of the canals were poorly built, allowing water to leak or evaporate. From the Qaraqum Canal, the largest in Central Asia, perhaps 30 to 75% of the water went to waste. Today, only 12% of Uzbekistan's irrigation canal length is waterproofed. Of the 47,750 km of interfarm irrigation channels in the basin, only 28% have anti-infiltration linings. Only 77% of farm intakes have flow gauges, and of the 268,500 km of onfarm channels, only 21% have anti-infiltration linings, which retain on average 15% more water than unlined channels.[22]

Satellite images show the changing water levels in the Aral Sea from 2000 to 2011.

By 1960, between 20 and 60 km^3 (4.8 and 14.4 cu mi) of water each year was going to the land instead of the sea. Most of the sea's water supply had been diverted, and in the 1960s, the Aral Sea began to shrink. From 1961 to 1970, the Aral's level fell at an average of 20 cm (7.9 in) a year; in the 1970s, the average rate nearly tripled to 50–60 cm (20–24 in) per year, and by the 1980s, it continued to drop, now with a mean of 80–90 cm (31–35 in) each year. The rate of water use for irrigation continued to increase; the amount of water taken from the rivers doubled between 1960 and 2000, and cotton production nearly doubled in the same period. In the first half of the 20th century prior to the irrigation, the sea's water level above sea level held steady at 53 m; this has changed drastically by 2010, when the large Aral was 27 m and the small Aral 43 m above sea level.[23]

Timeline of shrinking

The disappearance of the lake was no surprise to the Soviets; they expected it to happen long before. As early as 1964, Aleksandr Asarin at the Hydroproject Institute pointed out that the lake was doomed, explaining, "It was part of the five-year plans, approved by the council of ministers and the Politburo. Nobody on a lower level would dare to say a word contradicting those plans, even if it was the fate of the Aral Sea."[24]

The reaction to the predictions varied. Some Soviet experts apparently considered the Aral to be "nature's error", and a Soviet engineer said in 1968, "It is obvious to everyone that the evaporation of the Aral Sea is inevitable."[25] On the other hand, starting in the 1960s, a large-scale project was proposed to redirect part of the flow of the rivers of the Ob basin to Central Asia over a gigantic canal system. Refilling of the Aral Sea was considered as one of the project's main goals. However, due to its staggering costs and the negative public opinion in Russia proper, the federal authorities abandoned the project by 1986.[26]

From 1960 to 1998, the sea's surface area shrank by about 60%, and its volume by 80%. In 1960, the Aral Sea had been the world's fourth-largest lake, with an area around 68,000 km^2 (26,000 sq mi) and a volume of 1,100 km^3 (260 cu mi); by 1998, it had dropped to 28,687 km^2 (11,076 sq mi) and eighth largest. The salinity of the Aral Sea also increased: by 1990 it was around 376 g/L.[5] (By comparison, the salinity of ordinary seawater is typically around 35 g/L; the Dead Sea's salinity varies between 300 and 350 g/L.)

In 1987, the continuing shrinkage split the lake into two separate bodies of water, the North Aral Sea (the Lesser Sea or Small Aral Sea) and the South Aral Sea (the Greater Sea, or Large Aral Sea). In June 1991, Uzbekistan gained independence from the Soviet Union. Craig Murray, a UK ambassador to Uzbekistan in 2002, described the independence as a way for Islam Karimov to consolidate his power rather than a move away from a Soviet-style economy and its philosophy of exploitation of the land. Murray attributes the shrinkage of the Aral Sea in the 1990s to Karimov's cotton policy. The government maintained an enormous irrigation system which Murray described as massively wasteful, with most of the water being lost through evaporation before reaching the cotton. Crop rotation was not used, and the depleted soil and monoculture required massive quantities of pesticides and fertilizer. The runoff from the fields washed these chemicals into the shrinking sea, creating severe pollution and health problems. As the water supply of the Aral Sea decreased, the demand for cotton increased and the government reacted by pouring more pesticides and fertilizer onto the land. Murray compared the system to the slavery system in the pre-Civil War United States; forced labor was used and profits were siphoned off by the powerful and well-connected.[27]

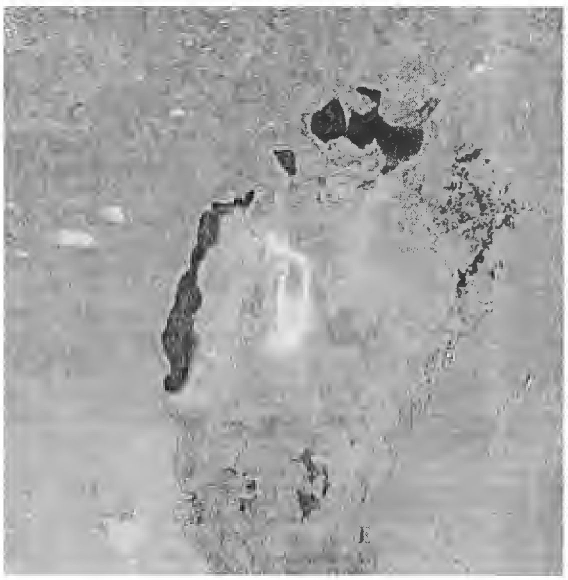
By summer 2003, the South Aral Sea was vanishing faster than predicted. In the deepest parts of the sea, the bottom waters were saltier than the top, and not mixing. Thus, only the top of the sea was heated in the summer, and it evaporated faster than would otherwise be expected. In 2003, the South Aral further divided into eastern and western basins.

In 2004, the Aral Sea's surface area was only 17,160 km^2 (6,630 sq mi), 25% of its original size, and a nearly five-fold increase in salinity had killed most of its natural flora and fauna. By 2007, the sea's area had further shrunk to 10% of its original size. The decline of the North Aral has now been partially reversed following construction of a dam (see below), but the remnants of the South Aral continue to disappear and its drastic shrinkage has created the Aralkum, a desert on the former lake bed.

The inflow of groundwater into the South Aral Sea will probably not in itself be able to stop the desiccation, especially without a change in irrigation practices.[28] This inflow of about 4 km^3 (0.96 cu mi) per year is larger than previously estimated. The groundwater originates in the Pamirs and Tian Shan Mountains and finds its way through geological layers to a fracture zone[29] at the bottom of the Aral.

The Aral Sea from space, North at bottom, August 1985

The Aral Sea from space, North at bottom, August 1997



The Aral Sea from space, North at top, August 2009

The Aral Sea from space, North at top, August 2017

Impact on environment, economy, and public health

The Aral Sea is considered an example of ecosystem collapse.[30] The ecosystems of the Aral Sea and the river deltas feeding into it have been nearly destroyed, not least because of the much higher salinity. The receding sea has left huge plains covered with salt and toxic chemicals resulting from weapons testing, industrial projects, and pesticides and fertilizer runoff. Due to the shrinking water source and subsequent worsening water and soil quality, pesticides were increasingly used starting in the 1960s to increase cotton yields, which further polluted the water with toxins such as DDTs.[31] Furthermore, "PCB-compounds and heavy metals" from industrial pollution contaminated both water and soil.[32] Due to the minimal amount of water left in the Aral sea, concentrations of these pollutants have increased drastically in both the water and soil. These substances form wind-borne toxic dust that spreads throughout the region. People living near the Aral Sea come in contact with pollutants through drinking water and inhalation of contaminated dust.[33] Furthermore, due to the presence in drinking water, the toxins have entered the food chain.[32] As a result, the land around the Aral Sea is heavily polluted, and the people living in the area are suffering from a lack of fresh water and health problems, including high rates of certain forms of cancer and lung diseases. Respiratory illnesses, including tuberculosis (most of which is drug resistant) and cancer, digestive disorders, anaemia, and infectious diseases are common ailments in the region. Liver, kidney, and eye problems can also be attributed to the toxic dust storms. All of this has resulted in an unusually high fatality rate among vulnerable parts of the population: the child mortality rate is 75 in every 1,000 newborns, and maternity death is 12 in every 1,000 women.[34] The dust storms also contribute to water shortages through salt deposition.[29] The overuse of pesticides on crops to preserve yields has made this worse, with pesticide use far beyond health limits.[29] Crops in the region are destroyed by salt being deposited onto the land and fields are being flushed with water at least four times per day to try to remove the salinity from the soils.[29] The land is decaying, causing few crops to grow besides fodder, which is what the farmers in Kazakhstan are now deciding to seed. (230)[35] Large bodies of water, like the Aral Sea, can moderate a region's climate by altering moisture and energy balance.[36] Loss of water in Aral Sea has changed surface temperatures and wind patterns. This has resulted in hotter summers and cooler winters (an estimated 2˚C-6˚C change in either direction) and the emergence of dust storms over the area.[36]

The Aral Sea fishing industry, which in its heyday employed some 40,000 and reportedly produced one-sixth of the Soviet Union's entire fish catch, has been devastated. In the 1980s commercial harvests were becoming unsustainable, and by 1987 commercial harvest became nonexistent. Due to the declining sea levels, salinity levels became too high for the 20 native fish species to survive. The only fish that could survive the high-salinity levels was flounder. Due to the declining sea levels, former fishing towns along the original shores have become ship graveyards.[37] Aral, originally the main fishing port, is now several miles from the sea and has seen its population decline dramatically since the beginning of the crisis.[38] The town of Moynaq in Uzbekistan had a thriving harbour and fishing industry that employed about 30,000 people;[39] now it lies miles from the shore. Fishing boats lie scattered on the dry land that was once covered by water; many have been there for 20 years.

Also destroyed is the muskrat-trapping industry in the deltas of the Amu Darya and Syr Darya, which used to yield as many as 500,000 pelts a year.[24]

Aral Sea dust storm, March 2010

Abandoned ship near Aral, Kazakhstan

A former harbour in the city of Aral

Local Kazakh fisherman harvesting the day's catch

Vulnerable populations

Women and children are the most vulnerable populations in this environmental health crisis due to the highly polluted and salinated water used for drinking and the dried seabed.[40] Toxins from pesticides have been found in blood and breast milk of mothers, specifically organochlorides, polychlorinated biphenyl compounds (PCBs), DDT compounds, and DDD.[41][32] These toxins can be, and often are, passed on to the children of these mothers resulting in low birthweight children and children with abnormalities. The rate of infants being born with abnormalities is five times higher in this region than in European countries.[42] The Aral Sea region has 26% of its children born at low birthweight, which is two standard deviations away from a national study population gathered by the WHO.[43] Exposures to toxic chemicals from the dry seabed and polluted water have caused other health issues in women in children. Renal tubular dysfunction has become a large health concern in children in the Aral Sea region as it is showing extremely high prevalence rates. Renal tubular dysfunction can also be related to growth and developmental stunting.[44] This, in conjunction with the already high rate of low birth weight children and children born with abnormalities, poses severe negative health effects and outcomes on children. These issues are compounded by the lack of research of maternal and child health effects caused by the demise of the Aral Sea. For example, only 26 peer-reviewed articles and four reports on children's health were produced between 1994 and 2008.[45] In addition, there is a lack of health infrastructure and resources in the Aral Sea region to combat the health issues that have arisen.[46] There is a lack of medication and equipment in many medical facilities, so health professionals do not have access to the necessary supplies to do their jobs in the Kazakhstan and Uzbekistan regions.[47] There is also meager development of a health information system that would allow for extensive research or surveillance of emerging health issues due to Aral sea issues.[47] An absence of a primary care approach in the health systems of this region also hinders services and access that could prevent and treat issues stemming from the Aral Sea crisis, especially in women and children.[47]

The impoverished are also particularly vulnerable to the environmental and health related effects of changes to the Aral Sea. These populations were most likely to reside downstream from the Basin and in former coastal communities.[48] They were also among the first to be detrimentally affected, representing at least 4.4 million people in the region.[49]

Considered to have the worst health in this region, their plight was not helped when their fishery livelihoods vanished with the decreasing levels of water and loss of many aquatic species.[50] Thus, those in poverty are entrenched in a vicious cycle.

Solution

Possible environmental solutions

Many different solutions to the problems have been suggested over the years, varying in feasibility and cost, including:

- Improving the quality of irrigation canals
- Using alternative cotton species that require less water[51]
- Promoting non-agricultural economic development in upstream countries[52]
- Using fewer chemicals on the cotton
- Cultivating crops other than cotton
- Redirecting water from the Volga, Ob and Irtysh rivers to restore the Aral Sea to its former size in 20–30 years at a cost of US$30–50 billion[53]
- Pumping sea water into the Aral Sea from the Caspian Sea via a pipeline, and diluting it with fresh water from local catchment areas[54]

In January 1994, Kazakhstan, Uzbekistan, Turkmenistan, Tajikistan, and Kyrgyzstan signed a deal to pledge 1% of their budgets to help the sea recover.

Cotton picking in Uzbekistan. Cotton is one of the biggest water consuming plants.[19]

In March 2000, UNESCO presented their "Water-related vision for the Aral Sea basin for the year 2025"[55] at the second World Water Forum in The Hague. This document was criticized for setting unrealistic goals and for giving insufficient attention to the interests of the area immediately around the former lakesite, implicitly giving up on the Aral Sea and the people living on the Uzbek side of the lake.[56]

By 2006, the World Bank's restoration projects, especially in the North Aral, were giving rise to some unexpected, tentative relief in what had been an extremely pessimistic picture.[57]

Aral Sea Basin Programme - 1

The future of the Aral Sea and the responsibility for its survival are now in the hands of the five countries: Kazakhstan, Uzbekistan, Tajikistan, Kyrgyzstan, and Turkmenistan. In 1994, they adopted the Aral Sea Basin Programme.[58] The Programme's four objectives are:

- To stabilize the environment of the Aral Sea Basin
- To rehabilitate the disaster area around the sea
- To improve the management of the international waters of the Aral Sea Basin
- To build the capacity of institutions at the regional and national level to advance the programme's aims

ASBP: Phase One

The first phase of the plan effectively began with the first involvement from the World Bank in 1992, and was in operation until 1997. It was ineffectual for a number of reasons, but mainly because it was focused on improving directly the land around the Aral Sea, whilst not intervening in the water usage upstream. There was considerable concern amongst the Central Asian governments, which realised the importance of the Aral Sea in the ecosystem and the economy of Central Asia, and they were prepared to cooperate, but they found it difficult to implement the procedures of the plan.

This is due in part to a lack of co-operation among the affected people. The water flowing into the Aral Sea has long been considered an important commodity, and trade agreements have been made to supply the downstream communities with water in the spring and summer months for irrigation. In return, they supply the upstream countries with fuel during the winter, instead of storing water during the warm months for hydroelectric purposes in winter. However, very few legal obligations are binding these contracts, particularly on an international stage.

ASBP: Phase Two

Phase Two of the Aral Sea Basin programme followed in 1998 and ran for five years. The main shortcomings of phase two were due to its lack of integration with the local communities involved. The scheme was drawn up by the World Bank, government representatives, and various technical experts, without consulting those who would be affected. An example of this was the public awareness initiatives, which were seen as propagandist attempts by people with little care or understanding of their situation. These failures have led to the introduction of a new plan, funded by a number of institutions, including the five countries involved and the World Bank.

ASBP: Phase Three

In 1997, a new plan was conceived which would continue with the previous restoration efforts of the Aral Sea. The main aims of this phase are to improve the irrigation systems currently in place, whilst targeting water management at a local level. The largest project in this phase is the North Aral Sea Project, a direct effort to recover the northern region of the Aral Sea. The North Aral Sea Project's main initiative is the construction of a dam across the Berg Strait, a deep channel which connects the North Aral Sea to the South Aral Sea. The Kok-Aral Dam is eight miles long and has capacity for over 29 cubic kilometres of water to be stored in the North Aral Sea, whilst allowing excess to overflow into the South Aral Sea.

Aral Sea Basin Programme - 2

On October 6, 2002, the Heads of States met again to revise the ASBP program. ASBP-2 was in place from 2003-2010. The main purpose of the ASBP-2 was to set up projects that covered a vast amount of environmental, socioeconomic and water management issues. The ASBP-2 was financed by organization such as the UNDP, World Bank, USAID, Asian Development Bank, and the governments of Switzerland, Japan, Finland, Norway and others. Over 2 billion US Dollars was provided by the IFAS country members to the program.[59]

Aral Sea Basin Programme - 3

On April 28, 2009 the Head of States came together with the Interstate commission for Water Coordination, Interstate Commission for Sustainable Development and National Experts and donors to develop the ASBP-3. This Program was in effect from 2011- 2015. The main purpose of the ASBP-3 was to improve the environmental and socio-economic situation of the Aral Sea Basin. The four program prioritizes were:[60]

- Direction one: Integrated Use of Water Resources
- Direction two: Environmental protection
- Direction three: Socio-economic Development
- Direction four: Improving the institutional and legal instruments

ASBP-3: Direction One

Direction One's main purpose is to propose program that focus on addressing transboundary water resources management, establishment of monitoring systems and addressing safety concerns in water facilities. Examples of programs that have been proposed include:[61]

- "Developing proposals to optimize the management and use of water resources in Central Asia, taking into account environmental factors, effects of climate change to meet the national interests of the Aral Sea basin."
- "Improving the quality of hydrometeorological services for weather-dependent sectors of the economy of Central Asia."
- "Creating a database and computer models for the management of transboundary water resources."
- "Assisting the countries in reducing the risk of natural disasters, including through the strengthening of regional cooperation, improve disaster preparedness and response."

ASBP-3: Direction Two

Directions two's main focus is on addressing the issues related to environmental protection and improvement of the environment. Areas of interest include:[62]

- "The environment in the deltas of the Syr Darya and Amu Darya improved."
- "Mountain environments improved."
- "The environment and productivity of pastures improved."
- "A regional information system on the environment established."

ASBP-3: Direction Three

Direction three looks to address socio-economic issues by focusing on education and public health, improving unemployment rates, improving water systems, increasing sustainable development and improving living conditions. The expected outputs are:[63]

- "An improved access to safe drinking water."
- "For the rural population: establishment and/or development of private small enterprises, creation of new jobs, and increased labor efficiency."
- "An improvement in the quality of medical services"
- "An improvement in the effectiveness and quality of education in schools and pre-school facilities in rural areas."

ASBP-3: Direction Four

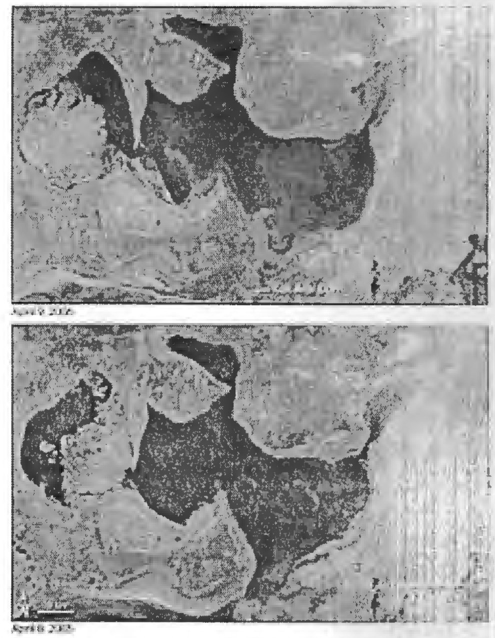
Direction Four aims to address issues related to institutional development and the development of policies and strategies that relate to sustainable development and public awareness. Expected outputs include:[64]

- "Conditions for a transparent and mutually beneficial regional dialogue and cooperation, including setting up a sectorial dialogue between governments established."
- "A Prototype of the single information and analysis system for the water sector established."

- "A Communication Strategy for stakeholders and the public established."
- "Training systems for the water sector and the hydrometeorological services in Central Asia improved."

North Aral Sea restoration work

Work is being done to restore in part the North Aral Sea. Irrigation works on the Syr Darya have been repaired and improved to increase its water flow, and in October 2003, the Kazakh government announced a plan to build Dike Kokaral, a concrete dam separating the two halves of the Aral Sea. Work on this dam was completed in August 2005; since then, the water level of the North Aral has risen, and its salinity has decreased. As of 2006, some recovery of sea level has been recorded, sooner than expected.[65] "The dam has caused the small Aral's sea level to rise swiftly to 38 m (125 ft), from a low of less than 30 m (98 ft), with 42 m (138 ft) considered the level of viability."[66]



Comparison of the North Aral Sea before (below) and after (above) the construction of Dike Kokaral completed in 2005.

Economically significant stocks of fish have returned, and observers who had written off the North Aral Sea as an environmental disaster were surprised by unexpected reports that, in 2006, its returning waters were already partly reviving the fishing industry and producing catches for export as far as Ukraine. The improvements to the fishing industry were largely due to the drop in the average salinity of the sea from 30 grams to 8 grams per liter; this drop in salinity prompted the return of almost 24 freshwater species.[37] The restoration also reportedly gave rise to long-absent rain clouds and possible microclimate changes, bringing tentative hope to an agricultural sector swallowed by a regional dustbowl, and some expansion of the shrunken sea.[67]

Comparison of the North Aral Sea in 2000 and 2011.

"The sea, which had receded almost 100 km (62 mi) south of the port-city of Aralsk, is now a mere 25 km (16 mi) away." The Kazakh Foreign Ministry stated that "The North Aral Sea's surface increased from 2,550 square kilometers (980 sq mi) in 2003 to 3,300 square kilometers (1,300 sq mi) in 2008. The sea's depth increased from 30 meters (98 ft) in 2003 to 42 meters (138 ft) in 2008."[2] Now, a second dam is to be built based on a World Bank loan to Kazakhstan, with the start of construction initially slated for 2009 and postponed to 2011, to further expand the shrunken Northern Aral,[68] eventually reducing the distance to Aralsk to only 6 km (3.7 mi). Then, it was planned to build a canal spanning the last 6 km, to reconnect the withered former port of Aralsk to the sea.[69]

Future of South Aral Sea

The South Aral Sea, half of which lies in Uzbekistan, was largely abandoned to its fate. Only excess water from the North Aral Sea is now periodically allowed to flow into the largely dried-up South Aral Sea through a sluice in the dyke.[70] Discussions had been held on recreating a channel between the somewhat improved North and the desiccated South, along with uncertain wetland restoration plans throughout the region, but political will is lacking.[65] Uzbekistan shows no interest in abandoning the Amu Darya river as an abundant source of cotton irrigation, and instead is moving toward oil exploration in the drying South Aral seabed.[69]

Attempts to mitigate the effects of desertification include planting vegetation in the newly exposed seabed; however, intermittent flooding of the eastern basin is likely to prove problematic for any development. Redirecting what little flow there is from the Amu Darya to the western basin may salvage fisheries there while relieving the flooding of the eastern basin.[71]

The Aral Sea in August 2010, with part of the eastern basin reflooded from heavy snowmelt.

Institutional bodies

The Interstate Commission for Water Coordination of Central Asia (ICWC) was formed on February 18, 1992 to formally unite Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan in the hopes of solving environmental, as well as socioeconomic problems in the Aral Sea region. The River Basin Organizations (the BVOs) of the Syr Darya and Amu Darya rivers were institutions called upon by the ICWC to help manage water resources. According to the ICWC,[72] the main objectives of the body are:

- River basin management
- Water allocation without conflict
- Organization of water conservation on transboundary water courses
- Interaction with hydrometeorological services of the countries on flow forecast and account
- Introduction of automation into head structures
- Regular work on ICWC and its bodies' activity advancement
- Interstate agreements preparation
- International relations
- Scientific research
- Training

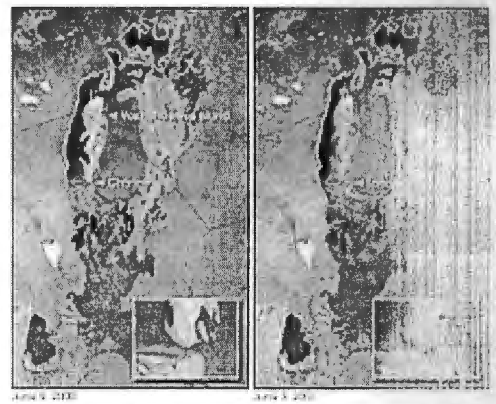
The Aral Sea completely loses its Eastern Lobe in August 2014

The International Fund for Saving the Aral Sea (IFAS) was developed on March 23, 1993, by the ICWC to raise funds for the projects under Aral Sea Basin programmes. The IFAS was meant to finance programmes to save the sea and improve on environmental issues associated with the basin's drying. This programme has had some success with joint summits of the countries involved and finding funding from the World Bank to implement projects; however, it faces many challenges, such as enforcement and slowing progress.[73]

Vozrozhdeniya

Vozrozhdeniya (Rebirth) Island, is a former island of the Aral Sea or South Aral Sea. Due to the ongoing shrinkage of the Aral, it became first a peninsula in mid-2001 and finally part of the mainland.[74] Other islands like Kokaral and Barsa-kelmes shared a similar fate. Since the disappearance of the Southeast Aral in 2008, Vozrozhdeniya effectively no longer exists as a distinct geographical feature. The area is now shared by Kazakhstan and Uzbekistan.

In 1948, a top-secret Soviet bioweapons laboratory was established on the island, in the centre of the Aral Sea which is now disputed territory between Kazakhstan and Uzbekistan. The exact history, functions and current status of this facility are still unclear, but bio-agents tested there included *Bacillus anthracis*, *Coxiella burnetii*, *Francisella tularensis*, *Brucella suis*, *Rickettsia prowazekii*, *Variola major* (smallpox), *Yersinia pestis*, botulinum toxin, and Venezuelan equine encephalitis virus.[75] In 1971, weaponized smallpox from the island reached a nearby ship, which then allowed the virus to spread to the city of Aral. Ten people there were infected, of whom three died, and a massive vaccination effort involving 50,000 inhabitants ensued (see Aral smallpox incident). The bioweapons base was abandoned in 1992 following the disintegration of the Soviet Union the previous year. Scientific expeditions proved this had been a site for production, testing and later dumping of pathogenic weapons. In 2002, through a project organized by the United States and with Uzbekistan's assistance, 10 anthrax burial sites were decontaminated. According to the Kazakh Scientific Center for Quarantine and Zoonotic Infections, all burial sites of anthrax were decontaminated.[76]


"Rebirth" Island joins the mainland in mid-2001.

Oil and gas exploration

Ergash Shaismatov, the deputy prime minister of Uzbekistan, announced on August 30, 2006, that the Uzbek government and an international consortium consisting of state-run Uzbekneftegaz, LUKoil Overseas, Petronas, Korea National Oil Corporation, and China National Petroleum Corporation signed a production-sharing agreement to explore and develop oil and gas fields in the Aral Sea, saying, "The Aral Sea is largely unknown, but it holds a lot of promise in terms of finding oil and gas. There is risk, of course, but we believe in the success of this unique project." The consortium was created in September 2005.[77]

As of June 1, 2010, 500,000 cubic meters of gas had been extracted from the region at a depth of 3 km.[78]

Films

The plight of the Aral coast was portrayed in the 1989 film *Psy* ("Dogs") by Soviet director Dmitri Svetozarov.[79] The film was shot on location in an actual ghost town located near the Aral Sea, showing scenes of abandoned buildings and scattered vessels.

In 2000, the MirrorMundo foundation produced a documentary film called *Delta Blues* about the problems arising from the drying up of the sea.[80]

In June 2007, BBC World broadcast a documentary called *Back From the Brink?* made by Borna Alikhani and Olly Creasey, which showed some of the changes in the region since the introduction of the Aklak Dam.

Bakhtyar Khudojnazarov's 2012 movie *Waiting for the Sea* deals with the impacts on people's life in a fishing town at the shore of the Aral Sea.

In 2012 Christoph Pasour and Alfred Diebold produced an 85-minute film with the title "From the glaciers to the Aral Sea", which shows the water management system in the Aral Sea basin and in particular the situation around the Aral Sea. The film was first screened at the 6th World Water Forum in Marseille, France, in 2012 and is now available on the website: www.waterunites-ca.org[81] and on Alfred Diebold's YouTube channel: waterunitesca.[82]

In October 2013, Al Jazeera produced a documentary film called *People of The Lake*, directed by Ensar Altay, describing the current situation.[83]

In 2014, director Po Powell shot much of the footage for the Pink Floyd single "Louder than Words" video near the remains of the Aral Sea on the border between Kazakhstan and Uzbekistan.[84]

Dry bottom of Aral Sea appears in 2017 film *Guardians*.

In October 2018, the BBC produced a programme called *Fashion's Dirty Secrets*, a large part of which shows the extent of the shrinking Aral and its consequences, together with maybe a little glimmer of hope.[85]

See also

- List of drying lakes
- Dead Sea
- Draining of the Mesopotamian marshes – a similar water diversion project in Iraq
- Lake Chad
- Salton Sea
- Sistan Basin – a large wetland ecosystem in Afghanistan and Iran on the verge of collapse
- Sudd – a large marshland in Africa, site of another planned large-scale draining project
- Tulare Lake - California's largest lake, drained between 1880-1970

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Methods for Catching Beetles

Author: Louis S. Hesler
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Julio, Carlos Aguilar, 2010. Methods for Catching Beetles. Naturalia Scientific Collection, Montevideo-Asuncion, 303 pp., 16 color pls., 139 figs., 14.8 × 21 cm. Soft cover, $76.

Beetles are the most speciose animal group; and they are found in virtually all habitats on Earth. *Methods for Catching Beetles* is a comprehensive general sourcebook about where and how to collect members of this diverse group. The book makes a compelling case in its Introduction about the value of scientific collecting to taxonomy and conservation. It then goes on to provide a broad overview of collection methods in general, and also presents tailored information on collecting specific families of beetles. It is particularly suited for those new at collecting beetles, but will also benefit veteran, field-oriented coleopterists who may be switching to study different families of beetles or to collect beetles in unfamiliar habitats. The book is intended to facilitate teaching of entomology, and it could realistically serve as a supplemental text in a taxonomic survey course, a collection methods course, or a special topics class on beetles. The relatively small size of the book makes it amenable to carry in the field, but it best serves readers as a good desk reference for devising an effective collecting trip.

Individual chapters are devoted to the basics of planning a collecting trip, a survey of environments, an overview of collection methods and traps, and a summary of killing and preservation methods. An especially strong feature is the chapter titled "Where do they live . . . ," which devotes nearly 100 pages on characteristics of individual beetle families—and often subfamilies and genera—and how to collect them. Information in the book is based primarily on the author's own extensive experience and that of 10 additional contributing experts, and the content is supported by a plethora of references current through year 2010 (pp. 264-303). A warm, helpful tone of the book is set by first-person language in the Introduction and at various other points, and by a smattering of personal tips and direct quotes of the main author's colleagues on collecting beetles. The book also benefits from 16 exquisite color plates, 139 black-and-white figures, and a glossary.

Catching Beetles is strictly a survey of qualitative methods for catching beetles. Hence, it lacks content on quantitatively assessing catches by calculating statistics and indices, analysis and comparison of collection methods and catches over time and among places, or any discussion of topics such as absolute versus relative sampling methods.

The book has a few shortcomings such as illogical subject organization. For instance, a section titled "Traps" (pp. 130-149) discusses general concepts (e.g. active vs. passive trapping) and several specific types of traps. However, some types of traps are described and discussed earlier in the book, e.g. bottle traps (pp. 70-71), light traps (pp. 89-95), and traps for xylophagous beetles (pp. 101-105). Another subsection titled "CAR-CATCHER" describes the design and use of vehicle-mounted traps, but it is inexplicably inserted about midway in the chapter on Environments. A chapter on "Killing Storing, Preserving and Rearing" contains no information on rearing, but tips on rearing beetles are given earlier in the book (e.g. rearing larvae in wood, pp. 106-108). More information could have been presented about collecting stored-product beetles, and an index would have been useful.

Better placement and use of definitions is often needed, particularly with regard to environments. For instance, lentic and lotic habitats are discussed one page before being defined, and then their individual definitions are quirkily repeated one and three pages later, respectively. In another instance under "Lakes and Ponds," several definitions are presented for pond, but lake is never defined. Moreover, no definitions of any of these terms appear in the glossary.

Stylistic flaws and deficient English-language editing reduce the book's readability. Small font also diminishes readability of the section on beetle families, and font size is inconsistent in a few sections. Text within a few figures is indecipherable.

References are beset by formatting errors, inconsistencies, and miswordings. Mistakes often occur in alphabetical and chronological sequencing of references. Several times references are alphabetized by an author's first rather than last name, although these references are often cited that way in the text. Wikipedia and other websites are referenced authoritatively a few times instead of relying on original references to support some points.

Nonetheless, the book's strengths far outweigh its shortcomings. It will prove a thorough, useful resource to inform readers and aid them in devising study methods to enhance knowledge of the Coleoptera.

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Veterinary Entomology: Livestock and Companion Animals

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WILLIAMS, R. E. 2010. Veterinary Entomology: Livestock and Companion Animals. CRC Press, Taylor and Francis Group, Boca Raton, FL, USA, xxvii + 343 pp. Hardback, ISBN 978-1-4200-6849-8, $99.95.

The protection of livestock and companion animals from pestiferous arthropods is of utmost concern to commercial agriculture, hobby farmers, veterinarians and pet owners. Veterinary Entomology: Livestock and Companion Animals is a concisely written and well-organized book that many readers will find extremely useful. This book has its origin in an earlier publication, with considerable updating and expansion into the companion animal area. Although this text will find its most use in college classrooms for teaching undergraduate veterinary or livestock entomology courses, it will be a valuable reference for anyone who regularly deals with these injurious pests in an extension capacity.

The book is organized into 15 chapters that include 2 introductory chapters: Importance of Arthropods, Principles of Arthropod Management, followed by 7 chapters demarking the primary groups of pests (Diptera, Myiasis-causing Diptera, Lice, Fleas, Mites, Ticks and Other Arthropod Groups of Veterinary Importance). Following the description of the individual pest players, the book takes the reader though the often-specialized pest management steps used in the agricultural and companion animal groups. These chapters use the following structure: Cattle, Swine, Sheep and Goat, Poultry, Equine and Pet. A selection of references and an index complete the book.

Chapter 1 provides a brief, but well summarized, overview of the types of parasitism, damage caused to animals by arthropods, and the use of economic injury levels. In Chapter 2, the reader is introduced to the unique methods of pest surveillance, types of pest management and an overview of the insecticides and application techniques used in veterinary entomology. This is particularly important as many products that can be used on other agricultural crops cannot be used on animals and many application techniques are specialized for animals (ear tags, pour-ons, and boluses).

To many of the non-entomologist readers, the array of insects found on livestock and pets is often overwhelming; requiring about two-thirds of this book to present. Additionally, this book predominantly covers the pests of the US and Canada, and as such, not all pests are present in all areas of these countries. Chapters 3, 4, 5, 6, 7, 8, and 9 present both the pests and their biological control agents to the reader in a repetitive format, first by introducing the geographic range, the importance, hosts or habitat, description and finally their biology/behavior. In following this approach, the reader can readily find the information that they require and easily move from the pest management chapters at the end of the book back into the arthropod-description chapter of interest. Each chapter is fronted by an overall description of the arthropod order (or sub-set, in the case of Chapter 4, Myiasis) followed by a very useful table outlining the taxonomic relationships of the specimens to be discussed. The distinction of pest status is often in the perception of the person being attacked or annoyed, or in the particular behavior or presence of a fly at a given time or place. Such perceptions are recognized and addressed throughout these chapters.

Chapters 3 and 4 cover the Diptera. Within Chapter 3, the material is divided into the biting and the non-biting flies. Although this presentation has little to do with their taxonomic placement, it does serve as an important structure for the reader to follow. Some of these flies are considered the most important arthropod pests of respective veterinary animals, and as such, their placement and detailed description is appropriate. In Chapter 4 the flies that cause myiasis (infestation of living vertebrates by dipteran larvae) is addressed. The flies discussed herein are some of the most fascinating and bizarre found in the animal kingdom. Students and the general public invariably are both intrigued and repulsed by these highly evolved parasites. The material in this chapter is introduced by providing a classification of the types of myiasis (dermal, gastrointestinal, etc. and obligatory/facultative/accidental). Within this chapter, images of the adult and immature flies as well as images of the parasitism sites on animals are presented. Here, in particular, color images would have made these images much more useful.

Each of the pest management chapters (10, 11, 12, 13, 14 and 15) follows a standard design, making locating information easy. Besides the geographic location, the livestock management system employed by the farmer or rancher will dictate which pests are likely to be problematic. As such, each system will in some respect, create their own problems, requiring specialized solutions. With respect to the filth flies that commonly plague cattle, swine, poultry and horses, the first step in successful pest management is to recognize the livestock management system used: type of confinement or pasture (cattle and horses). Because filth flies are among the most important pests of livestock, they have received considerable attention from research and extension professionals resulting in diverse pest management options. Therefore, the portions of chapters dealing with filth fly management are presented in greatest detail and are appropriate for much of the US and Canada. In each pest management program described, the following categories are used or summarized: surveillance, cultural/mechanical control, biological control and chemical control. For several of the other pests, the control options are much less diverse and therefore, their control section is condensed.

Chapters 14 and 15 deal with equine and pet pest management. These topics are not generally found in similar books and it is refreshing to see them addressed here. In particular, the information provided on flea management is of particular interest as veterinarians took over much of the flea control market in the 1990s when topical applications were made available. However, we may be seeing a return to a truly integrated program as fleas continue to develop insecticide resistance to these materials.

The book contains over 200 illustrations, including a four-page color plate. Many of the illustrations are exceedingly helpful; however, the book would have been aided greatly by the addition of more color images. The use of line drawings is of particular note, especially for some of the mite species from which it is notoriously difficult to obtain quality images. Beyond simply including images of the arthropods, the book contains many line drawings of life cycles that help to illustrate the importance of the use of pest biology when planning control tactics. Furthermore, the use of images of environmental conditions, animal management practices and pest management tactics greatly aids in the readers understanding of these often unique monitoring and control tactics.

Although this book provides an excellent overview of the arthropods to be expected in these commodities, the relationship of these pests to the disease-causing pathogens that many are vectors of is not strong. Many of the potential pathogens are touched upon, but some very important opportunities were missed, particularly in relation to the mosquito- and tick-borne pathogens. A chapter on the relationship of these vectors and their associated pathogens should be considered in a subsequent edition. Additionally, although this book presents a very good overview of the principles of pest management, the techniques will continue to evolve. The inclusion of information on where to locate additional information would be helpful (such as University Cooperative Extension programs or eXtension), perhaps at the end of each management chapter or at the end of the introductory chapter, with an inclusion in the index.

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First Report of Raoiella indica (Acari: Tenuipalpidae) in Colombia

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FIRST REPORT OF *RAOIELLA INDICA* (ACARI: TENUIPALPIDAE) IN COLOMBIA

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Raoiella indica Hirst (Acari: Tenuipalpidae), the red palm mite, is a phytophagous mite that recently invaded the Western Hemisphere. This mite was first detected in Martinique (Flechtmann & Etienne 2004) and it rapidly spread to multiple islands of the Caribbean [St. Lucia and Dominica (Kane et al. 2005), Guadeloupe and Saint Martin (Etienne & Flechtmann 2006), Puerto Rico and Culebra Island (Rodrigues et al. 2007), and Cuba (de la Torre et al. 2010) among other islands]. In 2007, the mite was found in West Palm Beach, Florida (FDACS 2007), and in the state of Sucre, Venezuela (Vásquez et al. 2008), and more recently, reported in the northern state of Roraima in Brazil (Marsaro Jr. et al. 2009), and Isla Mujeres and Cancun, Mexico (NAPPO 2009).

In January 2010, high populations of *R. indica* were found attacking coconut (*Cocos nucifera* L.), banana (*Musa acuminata* Colla) and heliconia (*Heliconia* sp.) plants in the Tayrona National Park located in the Colombian Caribbean littoral, near the city of Santa Marta, Magdalena. The presence of multigenerational colonies and exuvia was confirmed in 18 coconut palms, 4 heliconias and multiple banana plants located near the coast in the northern part of the park (11°18'44"N 73°56'04"W). In further surveys *R. indica* infestations were detected in commercial coconut and banana groves in June 2010 at Los Naranjos, Magdalena (11°17'49"N -73°53'49"W), approximately 6 km East of the Tayrona Park along the coast. In this locality the predatory mite *Amblyseius largoensis* Muma (Acari: Phytoseiidae) was found showing a conspicuous red coloration of the alimentary tract indicating recent feeding on *R. indica*. Previous studies indicated that populations of *A. largoensis* increased in numbers after the arrival of *R. indica* to Florida and some areas in the Neotropics (Peña et al. 2009; Carrillo et al. 2010).

Raoiella indica and *A. largoensis* specimens were collected (70% ethanol) and subsequently slide mounted, identified, and deposited in the collections of the Laboratory of Plant Quarantine reference collection, Embrapa Genetic Resources and Biotechnology, Brasilia, Brazil, and the Laboratory of Acarology from the Instituto Agroforestal Mediterráneo, Universidad Politécnica of Valencia, Spain.

The experienced negative effects of *R. indica* on coconut production in the Caribbean, where yield reduction has been estimated in over 50% at some locations (CARDI 2010), indicate the importance of adopting regulatory and other control measures in areas of recent invasion. The establishment of chemical practices needed to allow movement of host plant material, and continuous surveying (pre and post-invasion) using sentinel sites, have been adopted to prevent *R. indica*'s rapid dissemination in Florida (Roda et al. 2008). An integrated approach combining all available control tactics should be adopted and natural enemies identified for managing this species (Peña et al. 2009; Carrillo et al. 2010). In addition, studies are needed to determine the potential host plant range of *R. indica* in Colombia and the rest of the Neotropical region. Strict sanitary measures and other management tactics should be implemented to minimize the damage caused by *R. indica* in Colombia and other countries in South and Central America.

SUMMARY

In January 2010, high populations of *Raoiella indica* were reported for the first time in Colombia attacking coconut, banana, and heliconia plants in the Tayrona National Park. The predatory mite, *Amblyseius largoensis*, was found associated with *R. indica* in Los Naranjos, Magdalena. Strict sanitary strategies and other management tactics should be implemented to minimize the damage caused by *R. indica* in the Americas.

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Faster than a Flash: The Fastest Visual Startle Reflex Response is Found in a Long-Legged Fly, Condylostylus sp. (Dolichopodidae)

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FASTER THAN A FLASH: THE FASTEST VISUAL STARTLE REFLEX RESPONSE IS FOUND IN A LONG-LEGGED FLY, *CONDYLOSTYLUS* SP. (DOLICHOPODIDAE)

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Supplemental material online at http://www.fcla.edu/FlaEnt/fe942.htm#InfoLink4

Recently, fast reflex responses of skipper butterflies (Hesperiidae) to the photographic flash were reported and were found to be among the fastest ever recorded (<17 ms)—comparable to the fastest reflexes of the vertebrates (Sourakov 2009). Using a similar photographic technique, but a faster and more precise camera, even faster response times were found in *Condylostylus* flies (Diptera: Dolichopodidae). This new record reported here undoubtedly constitutes the fastest reflex response of a member of the animal kingdom ever recorded.

The observations were made in the Natural Teaching Laboratory, a forested area on the University of Florida campus, Gainesville, Florida. A *Condylostylus* sp. was photographed with a Canon EOS camera the built-in flash at a shutter speed of 1/200 s = 5 ms. Photographs in Fig. 1 were taken with an interval of ca. 20 s within a 4-min period. The fly, startled by the flash, was able to take flight 9 out of 10 times before the image was taken. As a result, the fly's image was repeatedly captured in flight (Fig. 1). The fly's visual startle reflex caused by the flash had a latent period of less than 5 ms and, perhaps, only 2 ms. Some habituation can occur as evidenced when the camera was fired consecutively 4 times: the fly did not react to the fourth flash and hence the fly remained in a resting position (Fig. 1D). However, the fly quickly recovered and continued reacting to the flash 20 s later. No other species of insects photographed during the same time in the same location with the same equipment, have exhibited similar behavior, which leads to conclusion that this extraordinary reaction time is particular to the long-legged flies.

While earlier studies considered startle reflexes to be particular to mammals, Hoy (1989) stated that "all behaviors that have survival value are likely to be found in all animals facing similar problems." For many insects, a quick escape by crawling or flying is the primary mode of defense. When moths react to the ultrasound produced by bats (Order Chiroptera), this evading behavior can be classified as an acoustic startle response (Hoy et al. 1989). The response latencies in noctuid moths (*Feltia* spp., *Leucania* spp., *Amathes normaniana* Grote, *Agrotis ypsilon* Rottemberg, *Ochropleura plecta* L. and *Euxoa obeliscoides* Guenée) are very short, on the order of tens of milliseconds (Roeder 1967). Mechano-receptive hairs on tail appendages of a cockroach, *Periplaneta americana* L., detect the change in air pressure caused by a fast approaching object, and can trigger an escape response in less than 50 ms (Camhi & Tom 1978). House flies, *Musca domestica* L., have a similar reaction time of 30-50 ms to a visual threat (Holmqvist 1994). The startle reflex of *Condylostylus* fly most certainly constitutes the fastest in insects, as it is 3-10 times faster than the previously reported reflex response times.

Considering a great variety of insect species (estimates range between 2 and 30 million species) it is not surprising that the fastest escape response time should be found in that particular group of animals. However, many insects rely on camouflage, living in shelters, thick exoskeleton with sharp spines, venomous bites, and toxic substances for defense. Defense by fast escape response can be costly to maintain, as it assumes a very high metabolic rate as well as constant alertness, which for a cold-blooded animal can be problematic. Skipper butterflies and dolychopodid flies—as different as they are—both have a habit of perching openly on the upper surfaces of leaves in sunny areas of forests. This allows them to attract mates and repel competitors by territorial behavior, but it also makes them obvious prey for birds.

Capturing these insects can be very difficult, whether for the entomologist with a net or for a bird, because of their rapid escape responses. The *Condylostylus* flies and some of the very fast species of skipper butterflies possess bright metallic colors. Why would animals that are not chemically defended advertise themselves so openly to potential predators? The explanation may lie (as suggested by Daniel Janzen, pers. comm.) in the ability to escape repeatedly from predators, and thereby instill in the memories of predators the learned reflex of avoiding this particular prey. Just like yellow-and-black coloration signals the poisonous nature of their certain prey to birds, the bright metallic colors probably became a sign of fast escape response. In nature, these energy-saving signals are beneficial to both prey and predators; and hence these related

New Records on the Geographical Distribution of South American Sharpshooters (Cicadellidae: Cicadellinae: Proconiini) and their Potential as Vectors of Xylella fastidiosa

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NEW RECORDS ON THE GEOGRAPHICAL DISTRIBUTION OF SOUTH AMERICAN SHARPSHOOTERS (CICADELLIDAE: CICADELLINAE: PROCONIINI) AND THEIR POTENTIAL AS VECTORS OF *XYLELLA FASTIDIOSA*

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The Proconiini comprises 422 species distributed in the continental Americas, the highest biodiversity is found in the Neotropical Region (Wilson et al. 2009). Members of the tribe Proconiini have been identified as vectors of many diseases caused by the bacteria *Xylella fastidiosa* Wells et al. 1978, which occurs only in the xylem of plants (Marucci et al. 2002).

Strains of *X. fastidiosa* cause diseases such as "Pierce's Disease" (PD) in grape (*Vitis vinifera* L.), "Phony Peach Disease" (PPD), "Coffee Leaf Scorch" (CLS), "Oleander Leaf Scorch" (OLS), and "Citrus Variegated Chlorosis" (CVC) among others. These incurable maladies produce substantial economic losses in a diverse variety of crops (Hernandez-Martinez et al. 2006).

In South America the major threat is CVC which has spread rapidly throughout Brazil (Lopes 1996). *X. fastidiosa* is also present in United States, México, Venezuela, Brazil, Paraguay, Uruguay, Argentina (Redak et al. 2004), and Costa Rica (Aguilar et al. 2005). However, CVC is not yet reported from the USA although it has the potential to threaten orange (*Citrus* × *sinensis* (L.) Osbeck) production in the Americas if a suitable vector is available (Damsteegt et al. 2006).

Diseases caused by *X. fastidiosa* have attained great importance worldwide as insect vectors of this pathogen have demonstrated an ability to spread, as happened with *Homalodisca vitripennis* (Germar), which invaded many islands in the Pacific Ocean (Pilkington et al. 2005). Pathogen acquisition and transmission by sharpshooters occurs because these insects feed exclusively on xylem fluids (Young 1968).

Despite this obvious importance, there are few studies from South America that have identified Proconiini species that can transmit *X. fastidiosa*. Moreover, there is no basic information on biology, geographic distributions, phenology, natural enemies or host plant associations for many South American Proconiini species. To address this shortcoming, work presented here provides new distributional records for thirteen South American Proconiini sharpshooters that may be potential vectors of *X. fastidiosa*.

The examined material is deposited in the following entomological collections of Argentina: Instituto Miguel Lillo (IMLA); Museo de Ciencias Naturales de La Plata (MLP) and Museo Argentino de Ciencias Naturales 'Bernardino Rivadavia' (MACN). Specific identification and distributional data were compiled from Young (1968), Marucci et al. (2002) and Wilson et al. (2009).

Examined Material

Acrogonia citrina Marucci & Cavichioli, PARAGUAY: Carumbé, III-1965, Golbach Leg., 1♂, 1♀, without information on host plant and collecting method (IMLA).

Acrogonia flavoscutellata (Signoret), ECUADOR: Santo Domingo, IV-1958, Weyrauch Leg., 1♀, without information on host plant and collecting method (IMLA).

Dechacona missionum (Berg), URUGUAY: 1♂, without date, no information on host plant and collecting method (MACN).

Diestostemma huallagana Young, BOLIVIA: 1♂ without date and locality (MACN).

Molomea consolida Schröder, ECUADOR: El Puyo, IV-1958, 1♂. PERÚ: Tingo María, 1♂; Chanchamayo, II-1939, 1♂ (IMLA). BOLIVIA: Santa Cruz, I-1958, Wygodzinsky Leg.; 1♂ (IMLA), 1♀ (MACN), without information on host plant and collecting method.

Molomea personata (Signoret), PERÚ: Fundo Génova, IV-2002, Logarzo-Varone Legs., 8♀♀, on papaw; V-2002, Logarzo Leg., 2♀♀, on grasses, by sweeping (IMLA).

Ochrostacta diadema (Burmeister), PARAGUAY: Itagua, I-1957, Montes Leg., 3♀♀, without information on host plant and collecting method (MLP).

Oncometopia rubescens Fowler, PERÚ: Fundo Génova, IV-2002, Logarzo Leg., 14♂♂, 16♀♀, on grasses and papaw; V-2002, Logarzo Leg., 16♂♂, 4♀♀, by sweeping (IMLA). PARAGUAY: Carumbé, San Pedro, I-1971, Golbach Leg., 1♀, without collecting method (IMLA).

Proconia fusca Melichar, BOLIVIA: 9♂♂, 4♀♀, without information on host plant and collecting method (MACN).

Tapajosa doeringi (Berg), PERÚ: Cuzco, Machu Picchu, II-1952, Monrós Leg., 1♂, without information on host plant and collecting method (IMLA).

Tapajosa rubromarginata (Signoret), PARAGUAY: Caaguazú, XII-2000, Logarzo Leg., 1♂, on weeds (MLP).

Tapajosa similis (Melichar), BRAZIL: I-1948, Cuezzo Leg., 1♂, without information on host plant and collecting method (IMLA).

Tretogonia callifera Melichar, PARAGUAY: Carumbé, 3♂♂, 2♀♀; Caaguazú, I-1965, 2♂♂, 3♀♀, without information on host plant and collecting method (IMLA).

In Table 1, we summarize the species recorded for Central and South America, the presence of *X. fastidiosa* and the new distribution data for the species listed here. Sharpshooters are known to occur in 24 of the 37 Central and S. America countries. No data are available for some islands associated with Central America and the Caribbean. This lack of information about the Proconiini in these countries is probably due to a deficiency in surveys and collections and not because of the absence of representatives of these insects in those territories.

Most studies investigating the transmission of *Xylella* have been conducted in the USA. In the Neotropics, the majority of studies have been made in Brazil (Redak et al. 2004). Some South America countries, such as Perú, Bolivia, Colombia, and Ecuador have more than 50 sharpshooter species capable of vectoring *X. fastidiosa*, but no reference to occurrence of this bacterium in those countries is available.

Most South American countries are at risk from *X. fastidiosa* because the bacterium has a wide host range and may be transported accidently to new areas via infected plant species. There are strong epidemiological relationships between the presence of Proconiini sharpshooters and incidence of the bacterium. Resulting diseases can take months or years to develop significant symptoms, or infections may remain asymptomatic and undetected while acting as reservoirs from which continued bacterial transmission can occur (Hopkins 1989).

We thank the museum curators who provided access to the specimens used from their entomological collections.

TABLE 1. KNOWN AND NEW DISTRIBUTION RECORDS FOR 13 SPECIES OF PROCONIINI COLLECTED IN CENTRAL AND SOUTH AMERICA.

	Acrogonia citrina	*Acrogonia flavoscutellata*	*Dechacona missionum*	*Diestostemma huallagana*	*Molomea consolida*	*Molomea personata*	*Ochrostacta diadema*	*Oncometopia rubescens*	*Proconia fusca*	*Tapajosa doeringi*	*Tapajosa rubromarginata*	*Tapajosa similis*	*Tretogonia callifera*	*Presence of X. fastidiosa*	*Total specimens*
Argentina			*		*		*			*	*	*		*	38
Bolivia			*	X	X				X				*		58
Brazil	*	*	*	*	*	*	*	*			*	X	*	*	142
British Guiana		*													18
Colombia		*						*					*		65
Costa Rica								*						*	49
Ecuador		X			X			*							68
El Salvador		*													12
French Guiana		*											*		25
México														*	80
Panama		*						*							30
Paraguay	X		*		*		X	X			X		X	*	24
Perú			*	*	X	X		X	*	X			*		95
Suriname													*		14
Uruguay			X				*								8
Venezuela		*						*						*	47

*Data from Young 1968, Takiya 2008, and Wilson et al. 2009.
X—Present work.

SUMMARY

Xylella fastidiosa is endemic to the Americas, it causes economically important diseases in a variety of different crops, and is transmitted by xylem-feeding sharpshooters. This paper provides new geographic records for Proconiini sharpshooters in South America which helps to better understand their distribution. To develop these new records, we examined material from 3 of the main entomological collections held in Argentina. As a result, 5 species are cited for the first time from Paraguay; 4 for Perú; 3 for Bolivia; 2 for Ecuador; and 1 each for Uruguay and Brazil. Some of the species could be vectors of *X. fastidiosa* because congeners of the species studied here are known to transmit this bacterium.

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First Records of Both Subspecies of Brachiacantha quadripunctata (Coleoptera: Coccinellidae) in Mississippi, U. S.A.

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FIRST RECORDS OF BOTH SUBSPECIES OF *BRACHIACANTHA QUADRIPUNCTATA* (COLEOPTERA: COCCINELLIDAE) IN MISSISSIPPI, U.S.A.

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Supplemental material online at http://www.fcla.edu/FlaEnt/fe942.htm#InfoLink3

Brachiacantha Dejean 1837 (Coleoptera: Coccinellidae: Hyperaspini) is a New World genus with approximately 50 species and subspecies distributed from Canada to Argentina (Leng 1911; Gordon 1985). *Brachiacantha quadripunctata* (Melsheimer) is distributed over the eastern United States with 2 allopatric subspecies that have distinct elytral color patterns (Leng 1911; Gordon 1985). The elytron of *B. quadripunctata quadripunctata* (Melsheimer) has a basal spot and an apical spot in females, and an additional humeral spot that is often confluent with the basal spot in males (Fig. 1). The elytron of *B. quadripunctata flavifrons* Mulsant has 1 marginal spot in addition to the basal and apical spots (Fig. 2). *Brachiacantha quadripunctata quadripunctata* has a northern distribution from Kansas to Massachusetts, and south into Arkansas and Tennessee, whereas *B. quadripunctata flavifrons* is distributed in the southeastern U.S. from North Carolina to northern Florida and westward to southern Alabama (Gordon 1985). Neither subspecies has been recorded from Mississippi (Gordon 1985). Leng (1911) stated that the distribution of *B. quadripunctata* includes Mississippi and Louisiana, but he provided no records of this species for those states. However, in reviewing curated beetles, we discovered specimens of both *B. quadripunctata quadripunctata* and *B. quadripunctata flavifrons* from Mississippi, and here report their first records from the state.

New records of adult beetles were obtained from specimens in insect collections at the University of Mississippi (UMIC) and Mississippi Entomological Museum (MEM), Mississippi State University. We failed to find any *B. quadripunctata quadripunctata* or *B. quadripunctata flavifrons* from Mississippi in the collection database

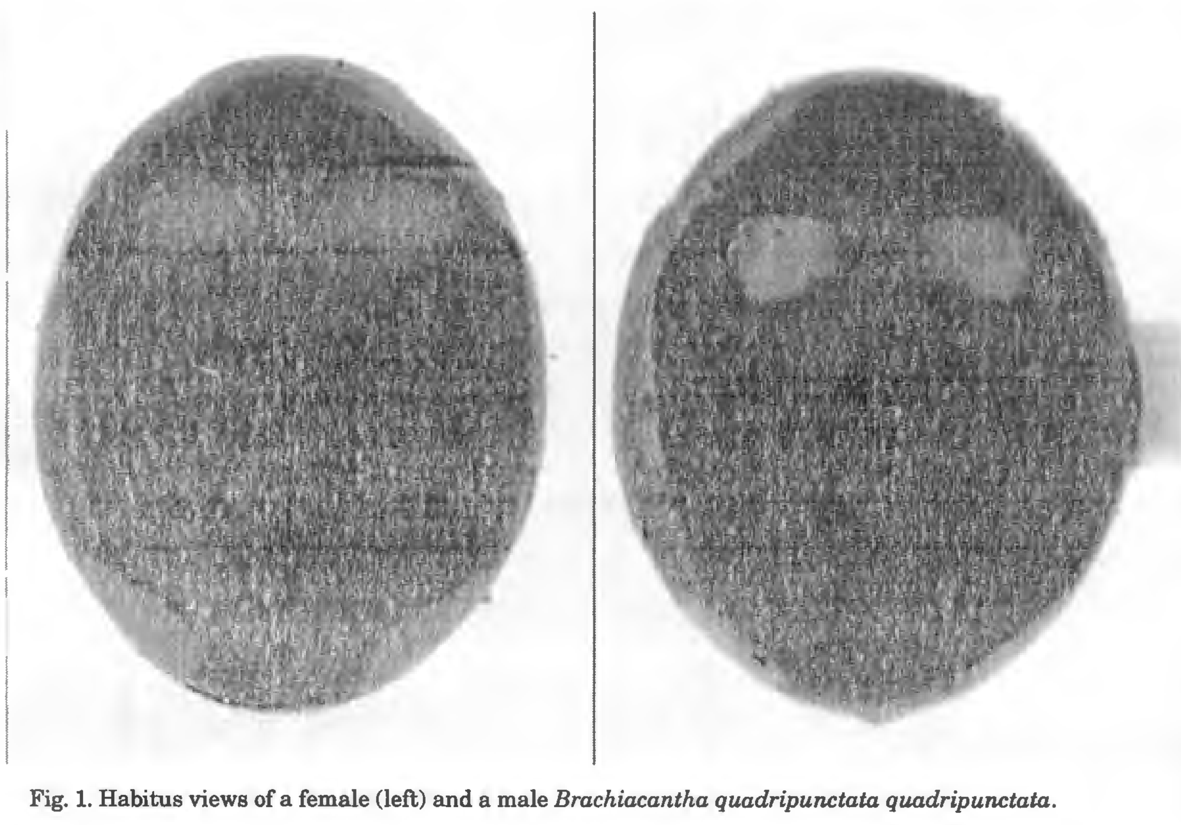

Fig. 1. Habitus views of a female (left) and a male *Brachiacantha quadripunctata quadripunctata*.

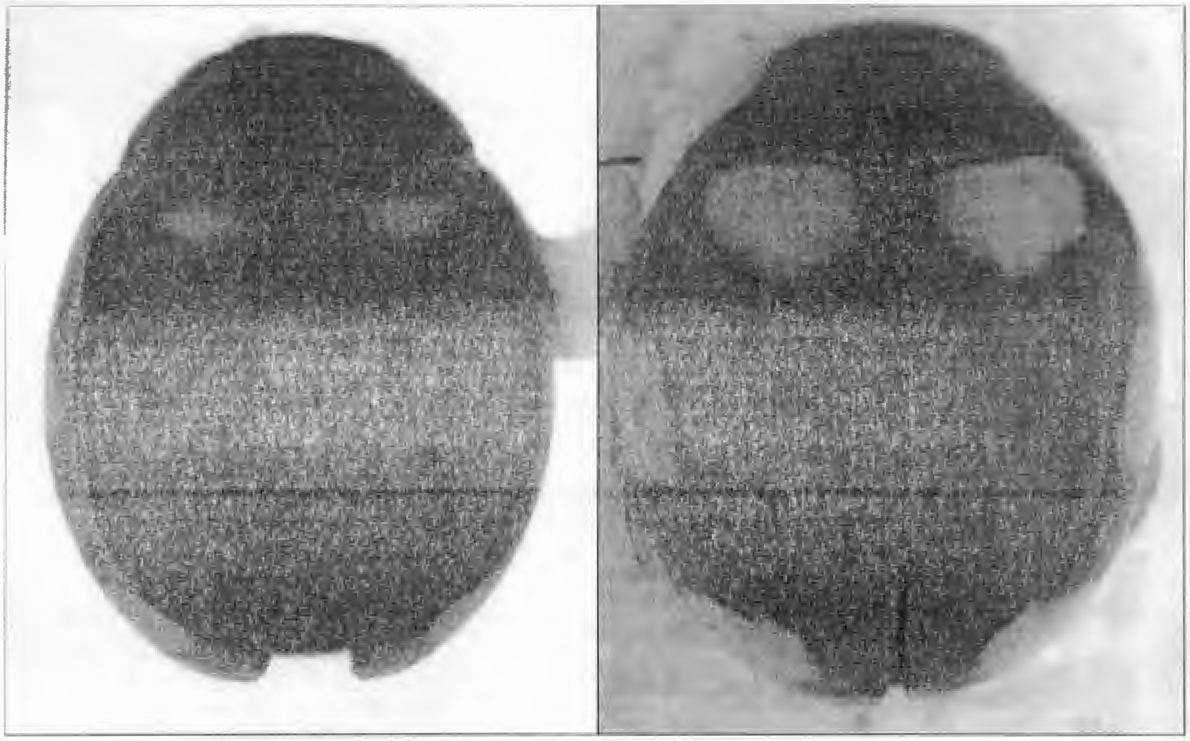

Fig. 2. Habitus views of a female (left) and a male *Brachiacantha quadripunctata flavifrons*.

at Louisiana State University (http://collection.silverbiology.com/lsam/collection/). In all, the following 15 specimens were recorded.

Brachiacantha quadripunctata quadripunctata. MEM: Choctaw County, 9 mi. NE Ackerman, 25-VI-1971, J. E. Leggett; Oktibbeha County, 4.3 SW Starkville, 9-III-1976, W. H. Cross; Winston County, near Noxapater, 1-III-1977, W. H. Cross; Oktibbeha County, Craig Springs, 5-III-1982, W. H. Cross; Oktibbeha County, Adaton, 15-III-1982, W. H. Cross; Noxubee County, Noxubee Wild. Ref., 8-III-1986, A. Tonhasca; Choctaw County, Jeff Busby Park, 4-IX-1992, R. L. Brown [2 adults]; Oktibbeha County, Starkville, Dorman Lake, 25-IV-1994, D. M. Pollock; Oktibbeha County, Starkville, Dorman Lake, 12-V-1995, D. M. Pollock; Winston County, Tombigbee National Forest, 33°0'20"N, 89°03'55"W, 10-V-1999, T. L. Schiefer; Choctaw County, Natchez Trace, mi. 199.4, 34°29'04"N, 89°11'52"W, 18-III-2004, T. L. Schiefer; Itawamba County, Natchez Trace, mi. 280.8, 34°26'41"N, 88°30'46"W, 13-III-2008, T. L. Schiefer.

UMIC: Grenada County, 6 mi. S. Grenada, 20-III-1992, M. S. Caterino.

Brachiacantha quadripunctata flavifrons. MEM: Choctaw County, 9 mi. NE Ackerman, 17-VI-1971, J. E. Leggett; Choctaw County, 9 mi. NE Ackerman, 25-VI-1971, J. E. Leggett.

Our discovery of specimens of *B. quadripunctata quadripunctata* and *B. quadripunctata flavifrons* from Mississippi establishes state records of these subspecies, and these records extend their known geographic distributions about 150 km, respectively, southward and westward. Moreover, their co-occurrence in Choctaw County in Jun 1971 shows that these subspecies are sympatric and synchronic in this part of their range, and contrast with previous collections records that have shown that *B. quadripunctata quadripunctata* and *B. quadripunctata flavifrons* are allopatric (Gordon 1985).

The presence of both subspecies of *B. quadripunctata* suggests that each elytral color phenotype is generally favored in Mississippi. However, additional studies are needed to determine whether distinct phenotypes are maintained possibly under genetic introgression between the 2 subspecies, or if phenotypes are maintained because introgression is limited or perhaps absent. Other studies are needed to survey for the 2 subspecies in other areas in which their ranges could potentially overlap (i.e., northern Alabama, northern Georgia, and eastern Tennessee).

Little is known about the bionomics of *Brachiacantha* species and factors that determine their abundance (Gordon 1985; Majka & Robinson 2009). For instance, there is only very limited information regarding the larvae of *Brachiacantha*, but in the few known instances they have been associated with root-feeding coccids and aphids found in ant nests (Leng 1911; Gordon 1985).

Wheeler (1911) found larvae of *B. quadripunctata quadripunctata* in nests of the ant, *Lasius flavus* (F.) (as *Lasius umbratus* var. *aphidicola*), provisioned with root coccids and root aphids, but we are unaware of any reports for *B. quadripunctata flavifrons*. Similarly, published accounts on the ecology of adult *Brachiacantha* are generally lacking (Acorn 2007; Majka & Robinson 2009). Thus, additional studies are needed to understand factors that may allow the subspecies of *B. quadripunctata* to overlap in distribution in Mississippi but drive allopatry between them in other areas.

Faunal lists may increase from additional collecting, curation and examination of previously collected material, and geographic range expansion of species (Fauske et al. 2003; McCorquodale & Bondrup-Nielsen 2004). In the present study, discovery of specimens of *B. quadripunctata quadripunctata* and *B. quadripunctata flavifrons* dating to 1971 came from the examination of previously collected material. This discovery reinforces the argument that ongoing curation and periodic review of collections is important in maintaining accurate regional lists of species for comparisons across geographic regions, and for developing hypotheses about changes in faunal distributions over time (Brodman et al. 2002; McCorquodale & Bondrup-Nielsen 2004; Hesler & Kieckhefer 2008).

Summary

The first records of the lady beetles *Brachiacantha quadripunctata quadripunctata* (Melsheimer) and *B. quadripunctata flavifrons* Mulsant from Mississippi and their occurrence in sympatry are reported following a review of previously collected material. The new records also extend the known geographic distribution of *B. quadripunctata quadripunctata* and *B. quadripunctata flavifrons* about 150 km, respectively, southward and westward. Our findings support the argument that ongoing curation and periodic review of collections is critical for maintaining accurate regional faunal lists, in developing hypotheses about the geographic distributions of species, and to track changes in both through time.

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