



# Genetic Preservation and Virtual Storage: for Sustainable Conservation

Ampika Thongphakdee (DVM, PhD, DTBT)  
Zoological Park Organization of Thailand under the Royal Patronage of H.M. the King

# Zoos reserve wildlife population

Connecting people with wildlife and nature

Raising awareness on the importance of wildlife and nature conservation

Providing standard captive management for animals, including good welfare and enrichment

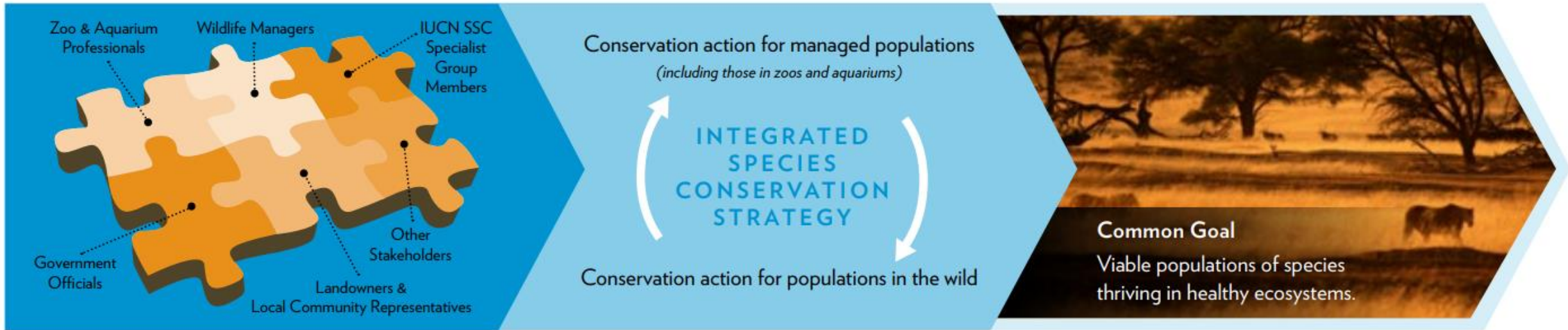
Conducting research for supporting conservation





# ONE PLAN APPROACH

to species conservation



# Animal Conservation and Research Institute (ACRI)



Khao Kheow Open Zoo, Chonburi



Provide better understanding of wildlife and apply science & technology to save wildlife

- Genetic
- Health
- Reproduction
- Nutrition
- Population management
- Wildlife Biobank





# Biobank: insurance for their future...



Whole blood  
DNA

199 species  
3,898 samples

Genetic



Serum  
Frozen/embedded  
tissue

>118 species  
19,970 samples

Diagnostic



Serum  
Fresh/extracted  
feces  
Urine

23 species  
7,010 samples

Endocrinology



Sperm  
Somatic cells  
Oocytes  
Embryos  
Ovarian/testicular  
tissues

40 species  
9,750 samples

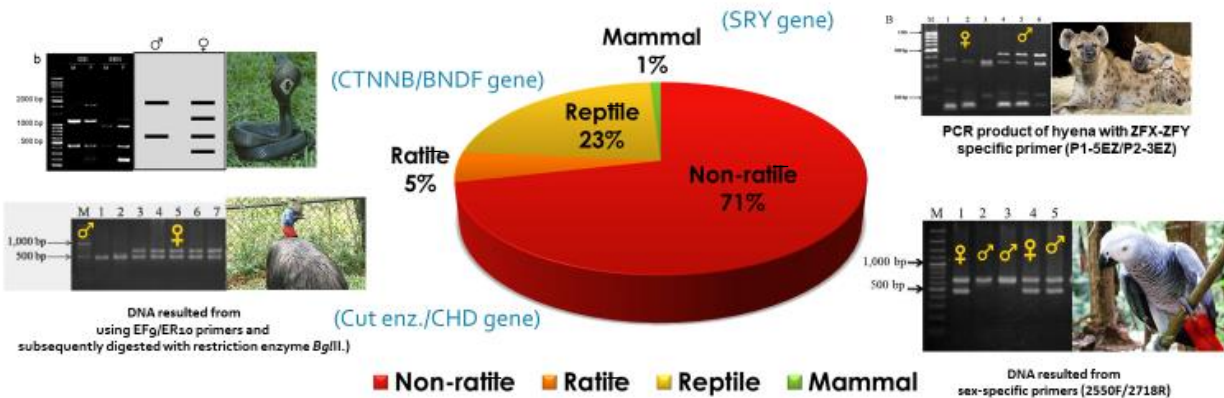
Reproduction



# Genetic

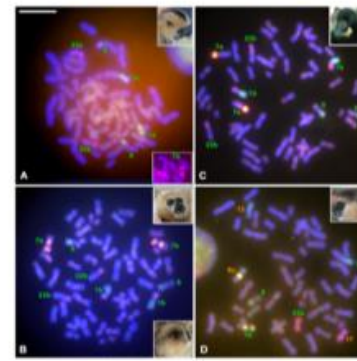
## Sex identification

We identified 1,623 samples consist of

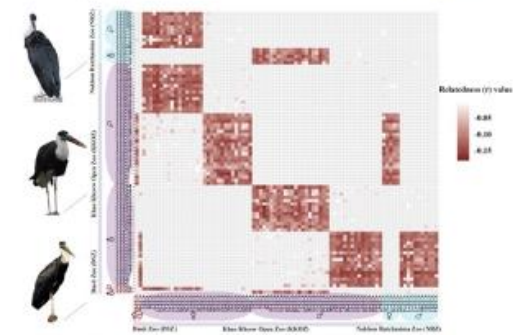


## Identification of species and genetic diversity

Cytogenetic: Chromosome characteristic



Molecular: Sequence of nucleotide



Baicharoen et al., *PLoS One*. 2014;9(10)

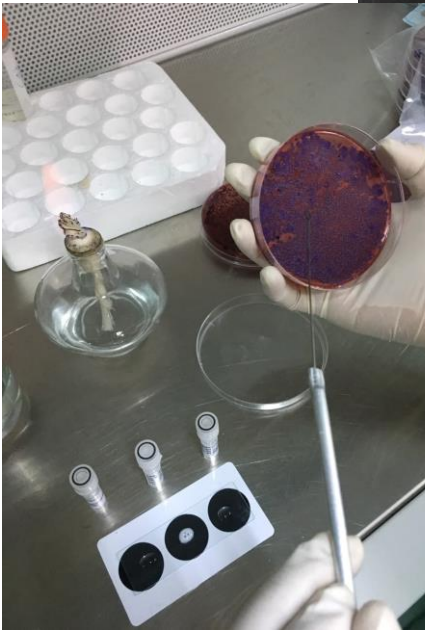
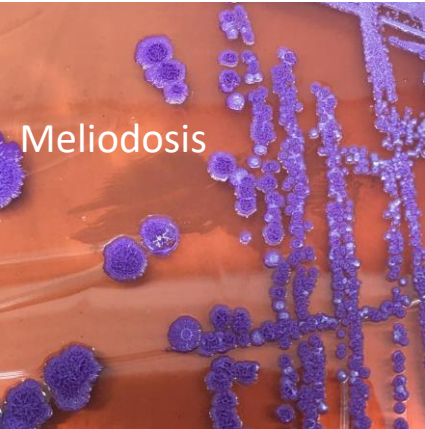
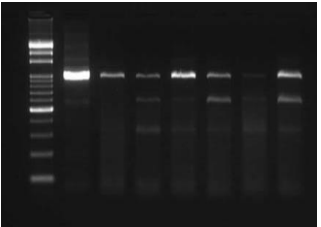
Jangtarwan et al., *PLoS One*. 2019;14(10)





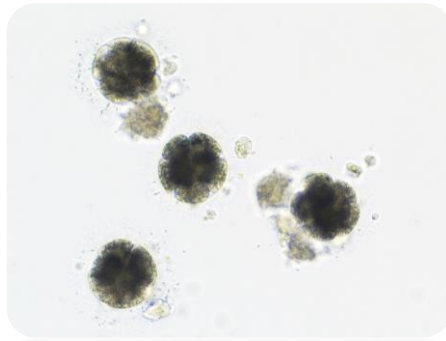
# Health (disease dx and proactive surveillance)

Psittacine beak and feather disease





# Reproduction



“Successful captive breeding supports the reintroduction program.”



Endangered Eld's deer (extinct in the wild of Thailand for 50 years) return back to the wild.



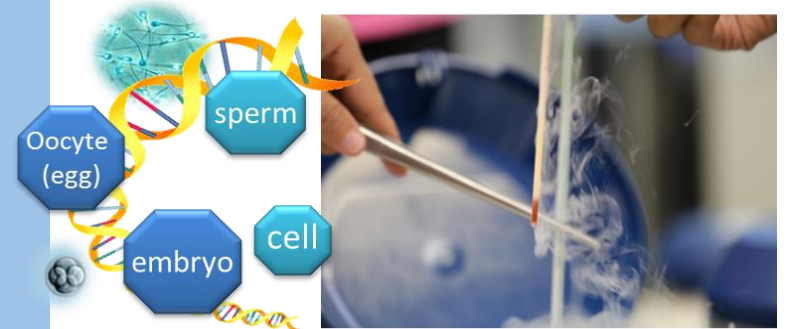


# Cryopreservation

Freezing or vitrification and storage of gametes, embryos or gonadal tissue.

## Purposes of cryopreservation

- Breeding management
  - Decrease disease transmission (lack of physical contact during mating)
  - Less time consuming for animal transportation
  - Reduce risk from transportation (zoo - zoo/ country - country )
- Genetic preservation
  - Valuable animals / Endangered species
  - Insurance against losses of genetic diversity or entire species
- Genetic exchange
  - Widen a gene pool of minority breeds or species
  - Biological material could be recovered from free-living animals without removing more individuals from native habitats.





# Artificial Insemination

AI is applied to propagate population of domestic animal with highly producing traits and the endangered species with valuable genetic.

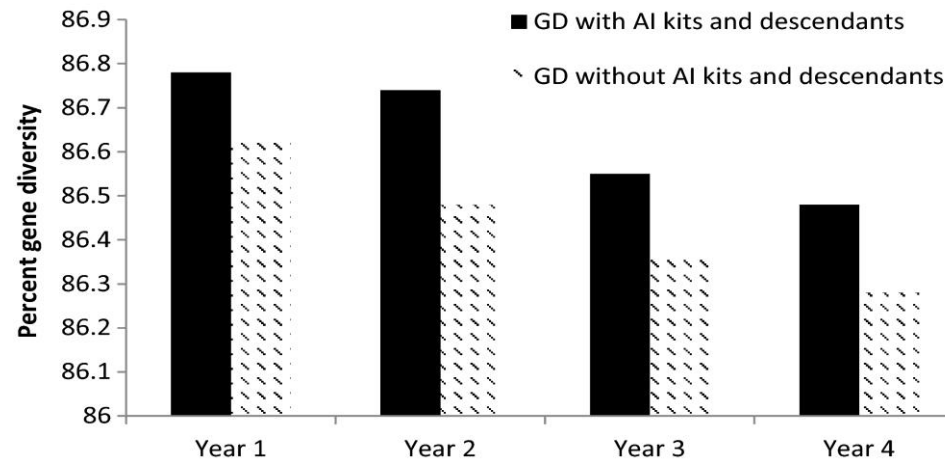
## Critically Endangered Black-Footed Ferret Diversity Improved by Using Frozen Sperm for Assisted Reproduction

Aug. 13, 2015



Dr. JoGayle Howard holds ferrets resulting from AI.

Recovery of gene diversity using long-term cryopreserved spermatozoa and artificial insemination in the endangered black-footed ferret



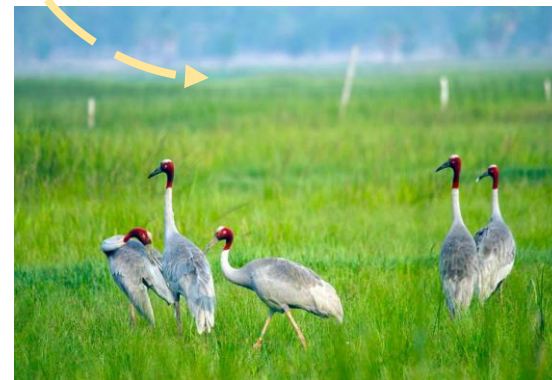
Animal Conservation, Volume: 19, Issue: 2, Pages: 102-111, 2015



species recovery programs



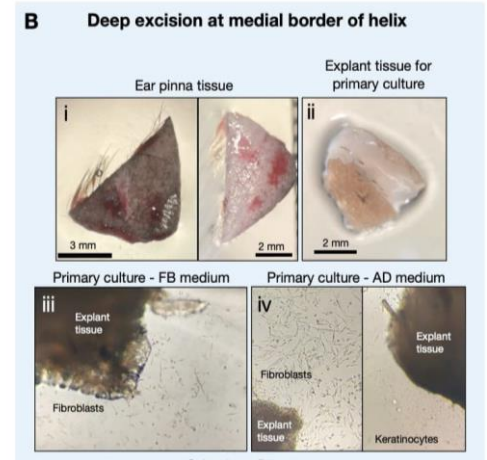
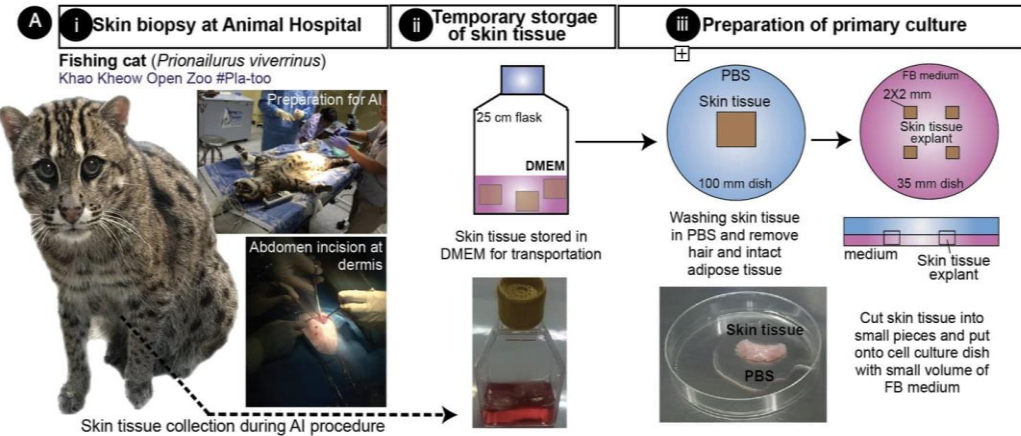
# Assisted Reproductive Technologies help to diversify genetic in the restricted population.







# "Fishing Cat Cell Biobanking for Conservation"





NEWS | 09 March 2023

## The mice with two dads: scientists create eggs from male cells



Only 7 out of 630 implanted mouse embryos gave rise to mouse pups. Hayashi said this low success rate — around 1%

## Saving animals from extinction?



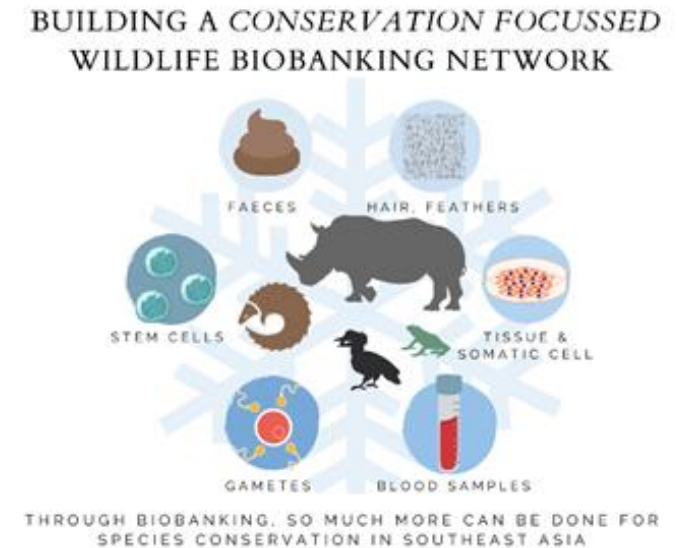
Tony Karumba/AFP/Getty Images

The technology could help the northern white rhino from going extinct. Najin (foreground), 30, and daughter Fatu, 19, are the last two of their kind on the planet.



# Moving forward...

- Biobank database managing system
- Reliable storage facilities (stable electricity supply, proper temperature control, transportation)
- Advance supporting system (safeguard of the bank)
- Back up storage facility (multiple locations)
- Networking regionally and globally to facilitate the sample exchange to maintain a diversified genetic gene pool



## Collaboration between NSTDA and ZPOT

for developing biobank database managing system, August 2022





# NRCT project (ZPOT&NBT)

## Backing up solution



Slide from NBT

# Virtual-storage management

## 1. Animal data store



- User management
- Animal accessions
- Purposes
- Link-outs to other zoo-software

## 2. Specimen management



- On site container
- Backup site container
- Specimen whereabouts
- Quality of specimen
- Dashboard and reporting

## 3. Equipment management



- Equipment information
- Location layout
- Equipment current status
- Notification system
- Dashboard and reporting





# Virtual-storage management

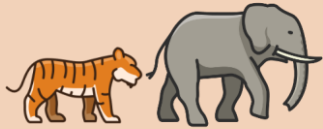


## Web-based DB access

User information



Animal information



Matching bio specimen

Linking via  
UNIFIED ID

## On site storage

Bio-specimen management



Storage management



## Backup storage

Bio-specimen management



Storage management



1 Sample selection  
To be backup


2 Paperless confirmation  
Handshaking with backup site

3 Shipment of samples  
Controlled environment

## User management

ลงทะเบียนสวนสัตว์

- Admin
- เพิ่มผู้ใช้งานในแต่ละสวนสัตว์
  - ชื่อ-สกุล
  - เบอร์โทรศัพท์
  - อีเมลล์
  - หน่วยงาน/สวนสัตว์
  - ตำแหน่ง



## Specimen management

Animal Biodata

- General info
  - สวนสัตว์ที่อยู่, จุดแสดง
  - ชื่อสามัญ, ชื่อวิทยาศาสตร์
  - เลขประจำตัว
  - ชื่อ/ห่วงขา/ไมโครชิพ
  - อายุ
  - เพศ
  - สถานะ (ป่วย, ตาย, ตรวจสอบสุขภาพ)
  - ข้อมูลประวัติการรักษา
  - ID ประจำตัวสัตว์ (ทางระบบระบุให้)


- Clinical pathology
- Molecular biology and diagnostic
- Microbiology
- ESCRI
- Pathology
- Tissue

QC

- ข้อมูลที่ทำกรการกรอก
- คุณภาพตัวอย่างที่เก็บ


LAB

- บันทึกผลการตรวจตัวอย่าง
- Clinical pathology \*FM\_LB\_03
- Molecular biology and diagnostic \*FM\_LB\_02
- ESCRI \*FM\_LB\_04
- \*แบบฟอร์ม Lab Cell Culture



## Storage Management

- Freezer -20
- Freezer -80
- Storage N2



\*กรณีที่มีตัวอย่างเก็บที่ NBT หรือ site อื่นๆ สามารถดูตำแหน่งได้ แต่ไม่สามารถแก้ไขได้

- ### User roles
- Public user
  - Zoo coordinator - depositor ?
  - QC staff & senior Vet
  - Storage/equipment manager
  - Storage Operator
  - Admin

- สวนสัตว์
- ส่วนกลาง
- User
- Admin



- ผู้ประสานงานสวนสัตว์ ( User )




- เจ้าหน้าที่ QC
- Senior VETS




### User info

### Organization info



### Specimen info

- Dawin core API
- Species 360
- ZIM
- THBif



### Storage info

- Container API ?




### Equipment info

- Manage equipment
  - Add/view/edit/delete
- Maintain & Monitoring
  - record
- Notification

- Register
- Login / logout
- Edit profile
- Assign role

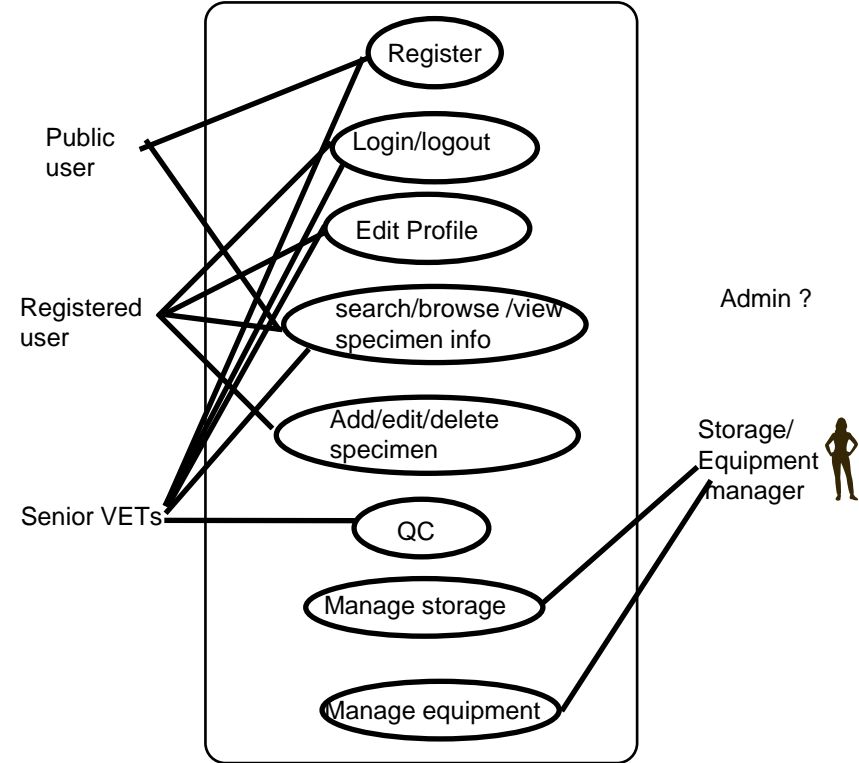
### QC/Approval

- Add new specimen
- View specimen info
- Edit specimen info
- Delete specimen



- View specimen info
- Approve

- Manage container
  - Add/view/edit/delete
  - View specimen info ?





- Genetic preservation and establishment of biobanking have a critical role to play in genetic, medical and reproductive research that facilitate sustainable conservation.
- V-storage system would support the effective genetic preservation, reliable storage facility, ability to access of biospecimens for new research and bridge the gap of genetic exchange b/w institutes.



THANK YOU

