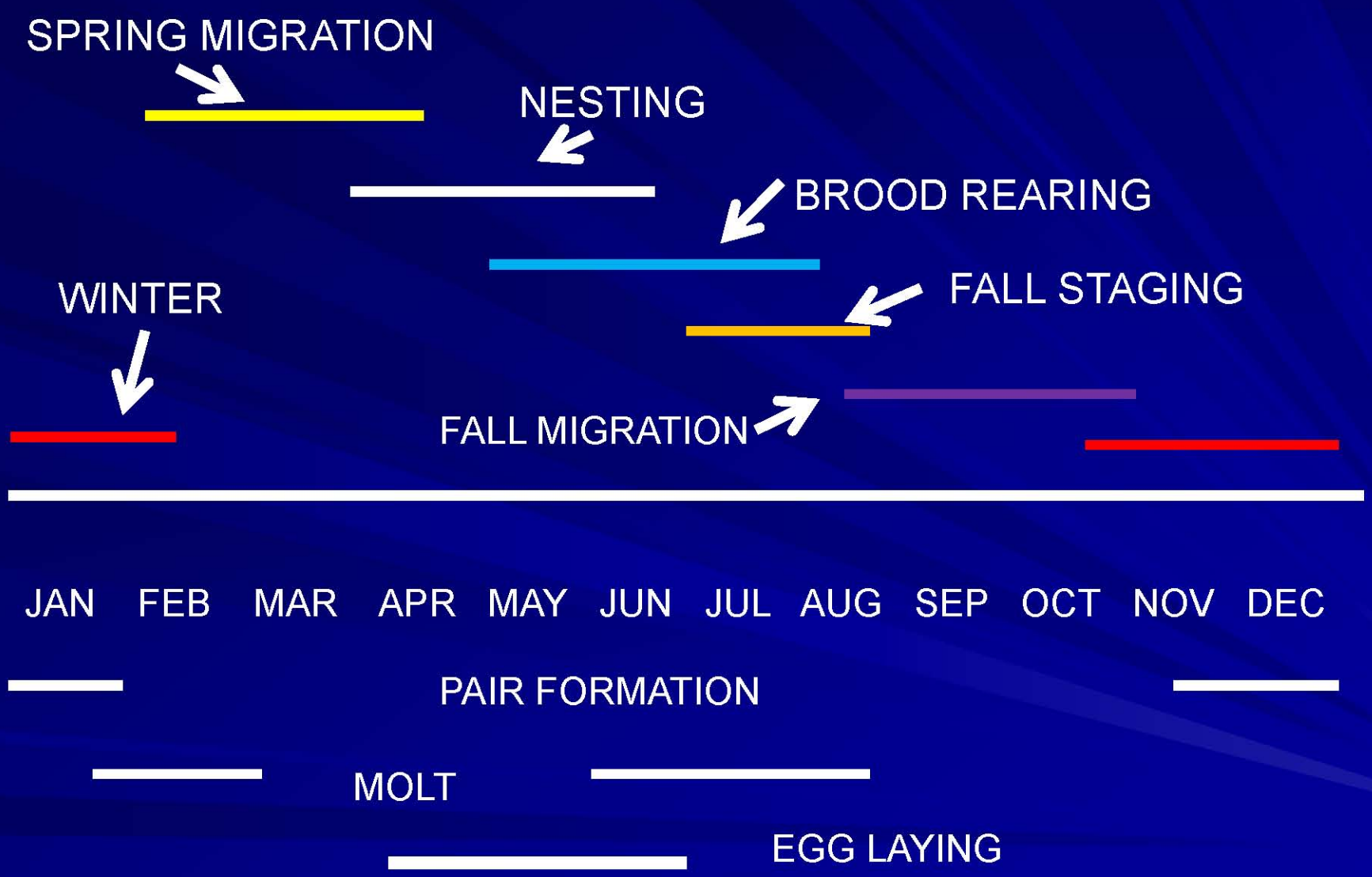
La importancia de los bioenergéticos como fundamento del uso de los humedales por las aves

Leigh Fredrickson

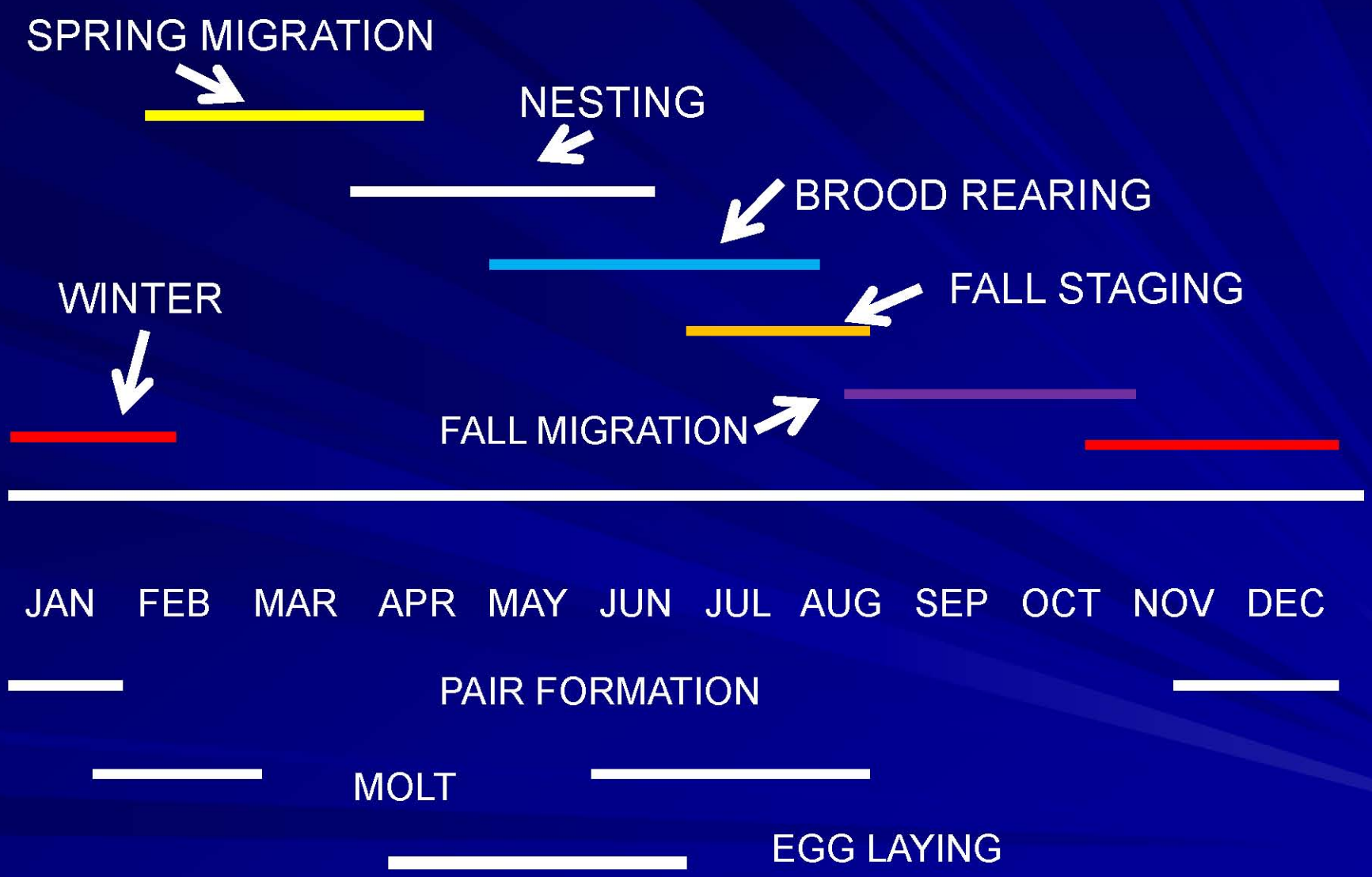
Manejo de humedales para técnicos en México II
LAGUNA MEXICANOS CHIHUAHUA
4-7 March 2014

Energetics Identify

- What resources are needed
- When in the annual cycle are these resources needed
- For how long are the resources needed
- The amount of resources that are needed
- The energetic cost of acquiring the needed resources


SPRING MIGRATION
NESTING
BROOD REARING
WINTER
FALL STAGING
FALL MIGRATION
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
PAIR FORMATION
MOLT
EGG LAYING

WINTERING WATERFOWL ENERGETICS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FALL MIGRATION
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
PAIR FORMATION
MOLT
EGG LAYING

ENERGETIC CONNECTIONS

- What specific life history events occur during each season?
- Are the events and their duration the same for both sexes and different ages?
- How long does the event last for the individual and the population and does this vary at different locations?
- What resources are required and are they the same for both sexes and/or ages?

LATE WINTER MOLT AND PLUMAGE FUNCTIONS

FEMALE - PREBASIC

SIGNAL

SEPARATION OF ENERGETICALLY EXPENSIVE ACTIVITIES

CAMOFLAUGE FOR NESTING

DARK DOWN FOR NEST INSULATION AND CONCEALMENT

MALE - SUPPLEMENTAL

SIGNAL

REPLACEMENT OF WATER WORN PLUMAGE

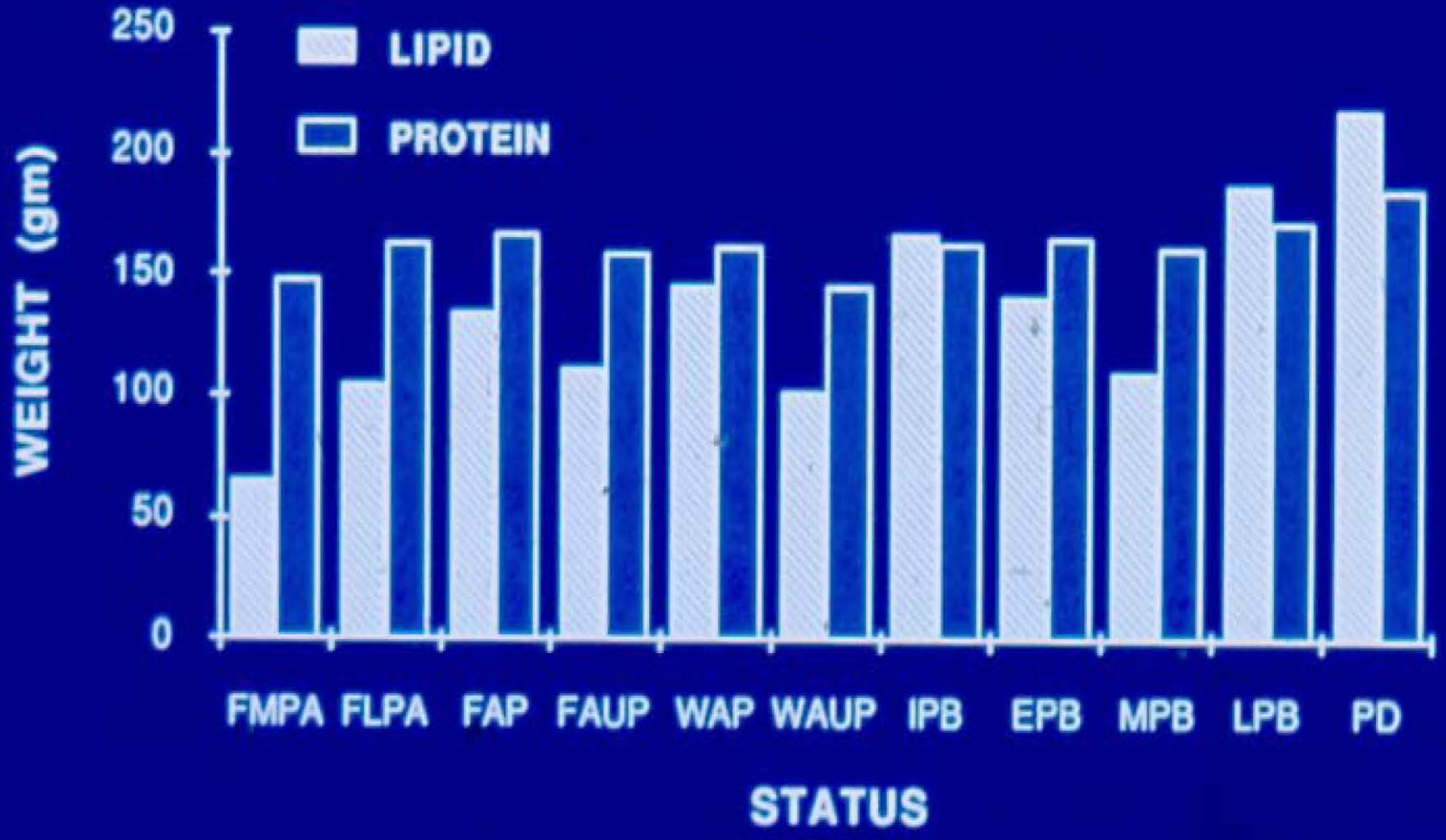
1981-82

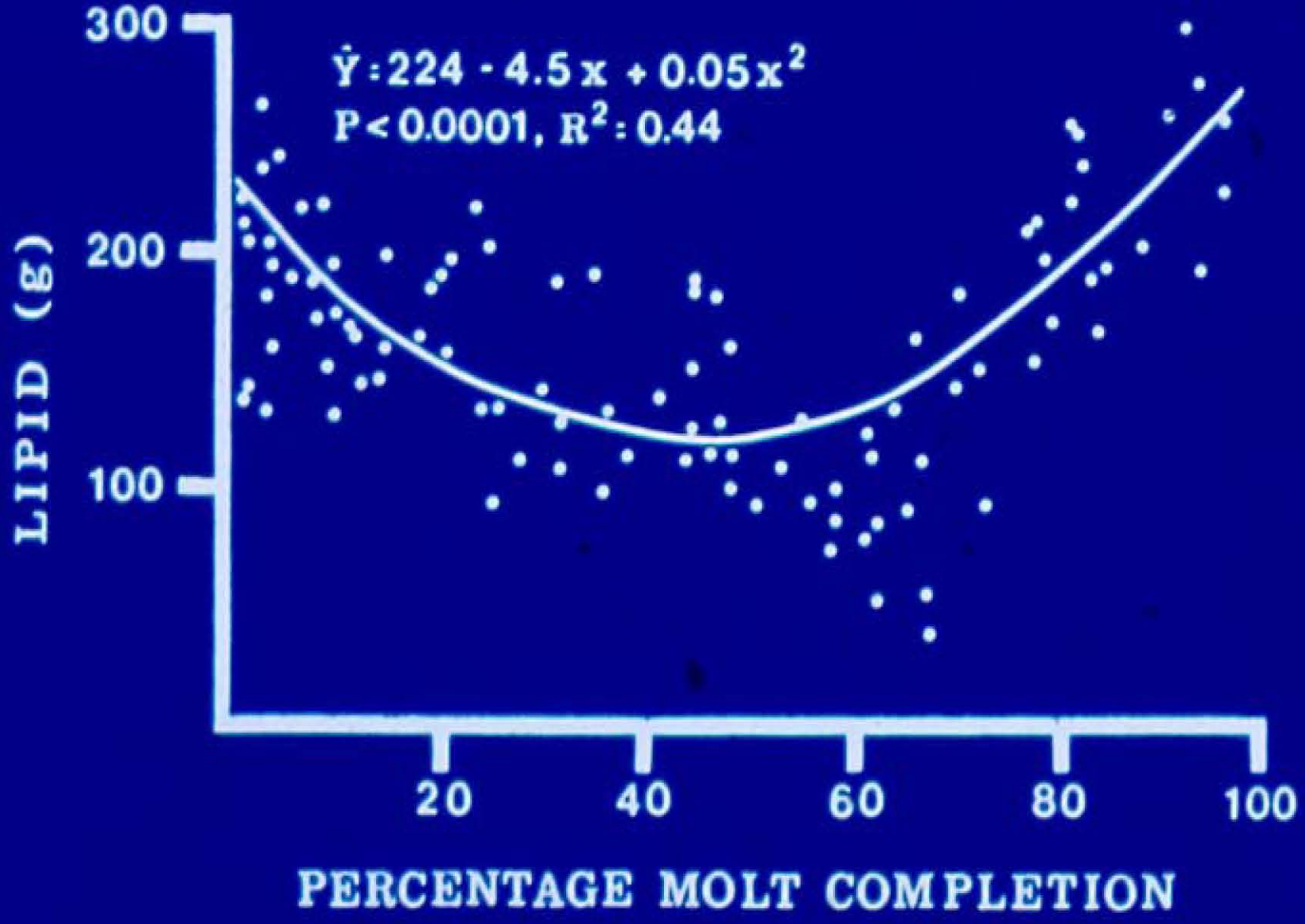
	DEC	JAN	FEB	MAR
UNPAIRED				
MOLTING	0	0	1	6
NOT MOLTING	5	12	6	1
PAIRED				
MOLTING	8	11	24	22
NOT MOLTING	4	4	2	0

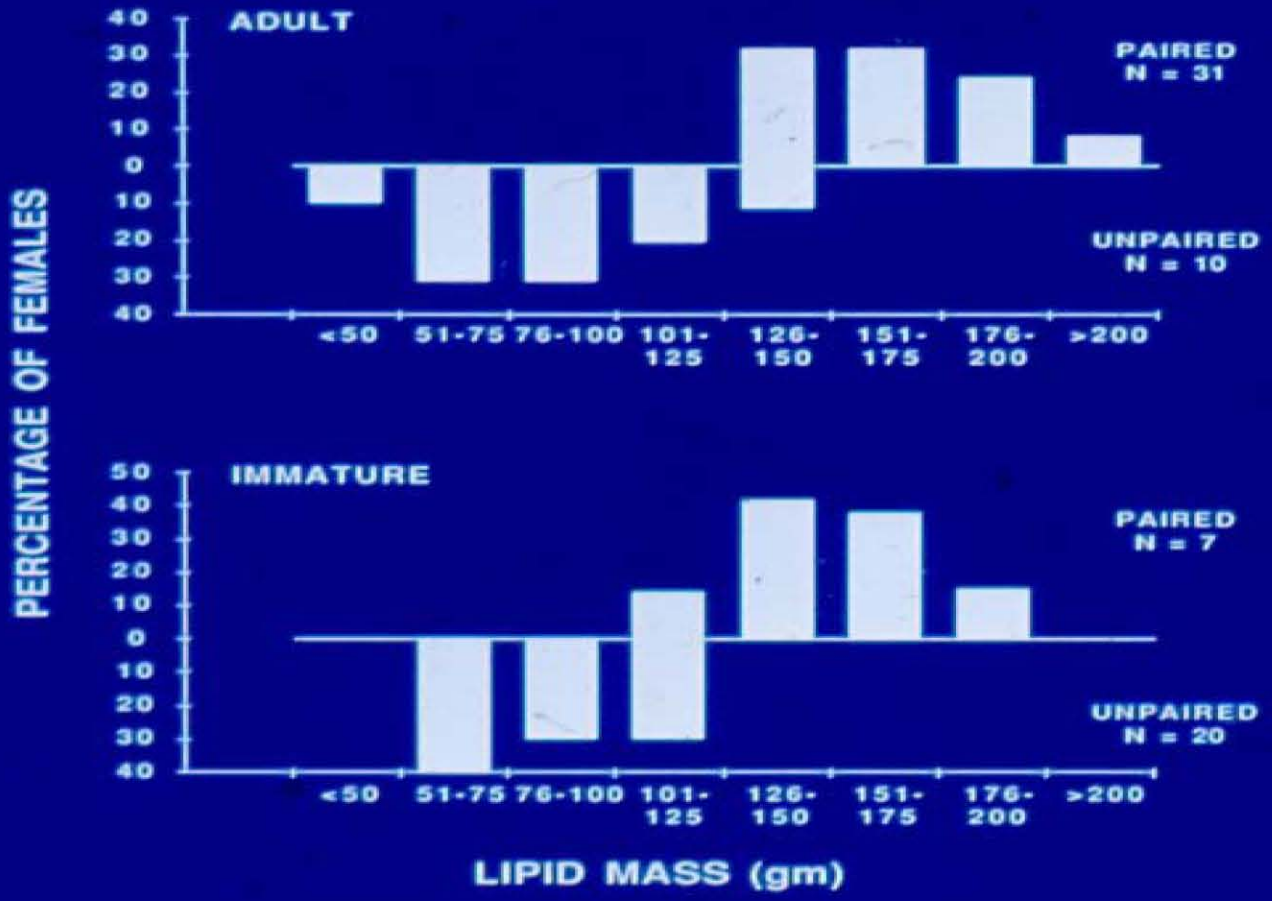
	80-81	81-82	82-83
1st PREBASIC INITIATION	22 JAN	15 DEC	7 DEC
1st PREBASIC COMPLETION	22 FEB	6 FEB	8 JAN
WINTER WETLAND CONDITION	DRY	SEMI-WET	WET

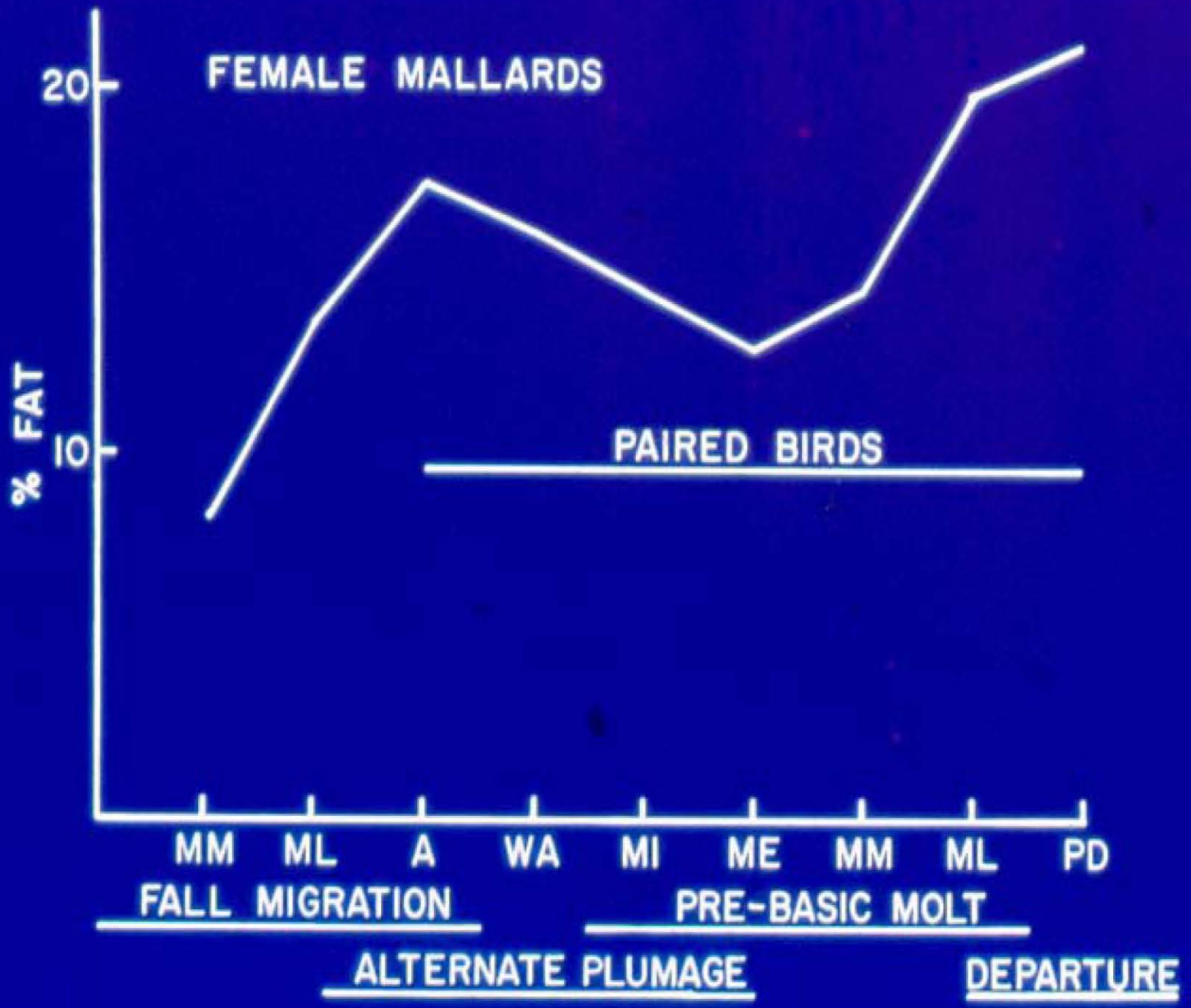
FEMALE MALLARD BODY WEIGHT IN WINTER

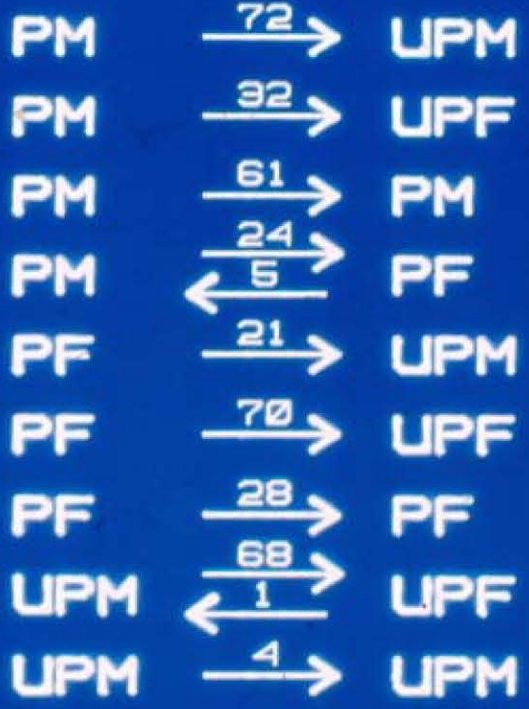
FEMALE MALLARD BODY COMPOSITION




$\hat{Y} = 224 - 4.5x + 0.05x^2$
$P < 0.0001$, $R^2 = 0.44$
LIPID (g)
300
200
100
20
40
60
80
100
PERCENTAGE MOLT COMPLETION


ADULT
PAIRED
N = 31
UNPAIRED
N = 10
40
30
20
10
0
10
20
30
40
<50
51-75
76-100
101-125
126-150
151-175
176-200
>200
IMMATURE
PAIRED
N = 7
UNPAIRED
N = 20
50
40
30
20
10
0
10
20
30
40
PERCENTAGE OF FEMALES
LIPID MASS (gm)


FEMALE MALLARDS
20
10
% FAT
PAIRED BIRDS
MM
ML
A
WA
MI
ME
MM
ML
PD
FALL MIGRATION
PRE-BASIC MOLT
ALTERNATE PLUMAGE
DEPARTURE

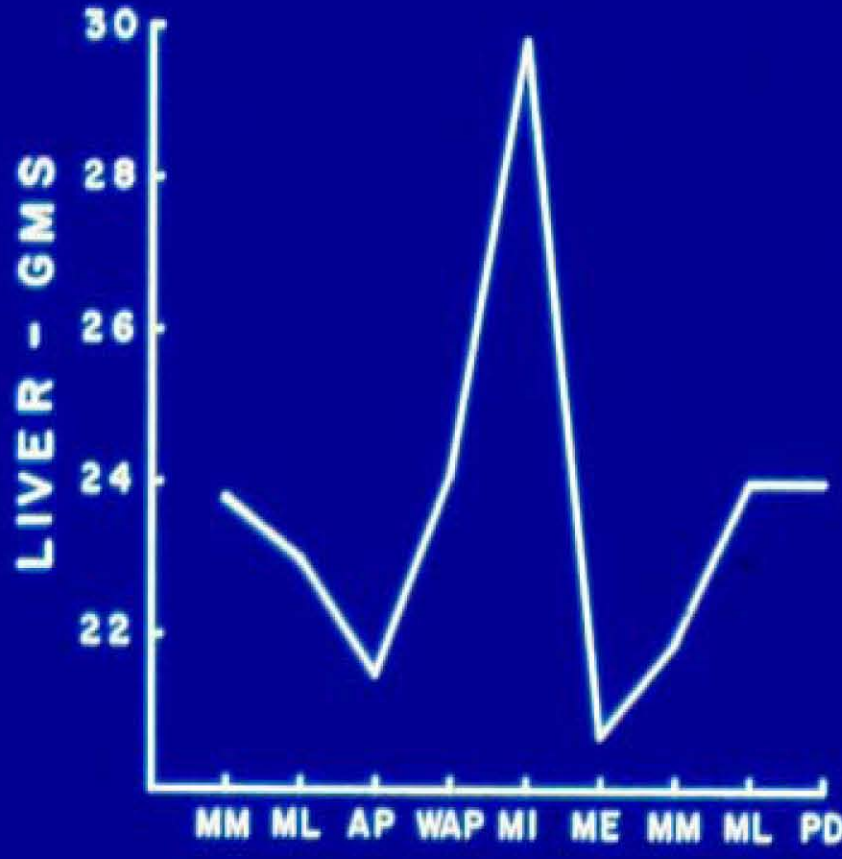


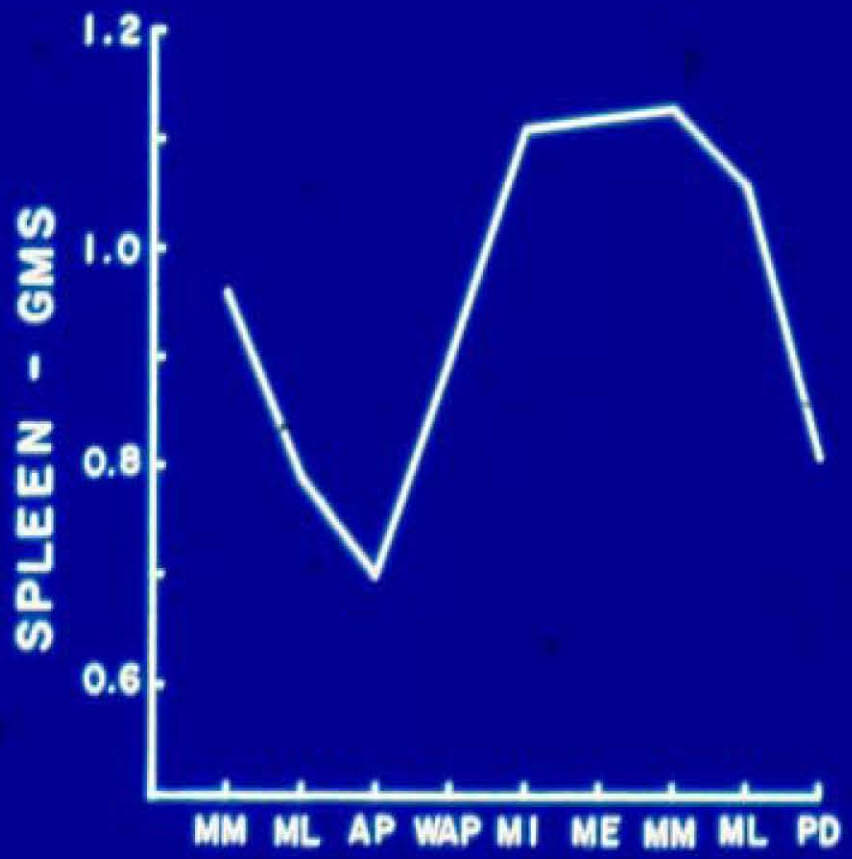
PM	>	PF	>	UPM	>	UPF
49.0		92.1		18.6		0.9

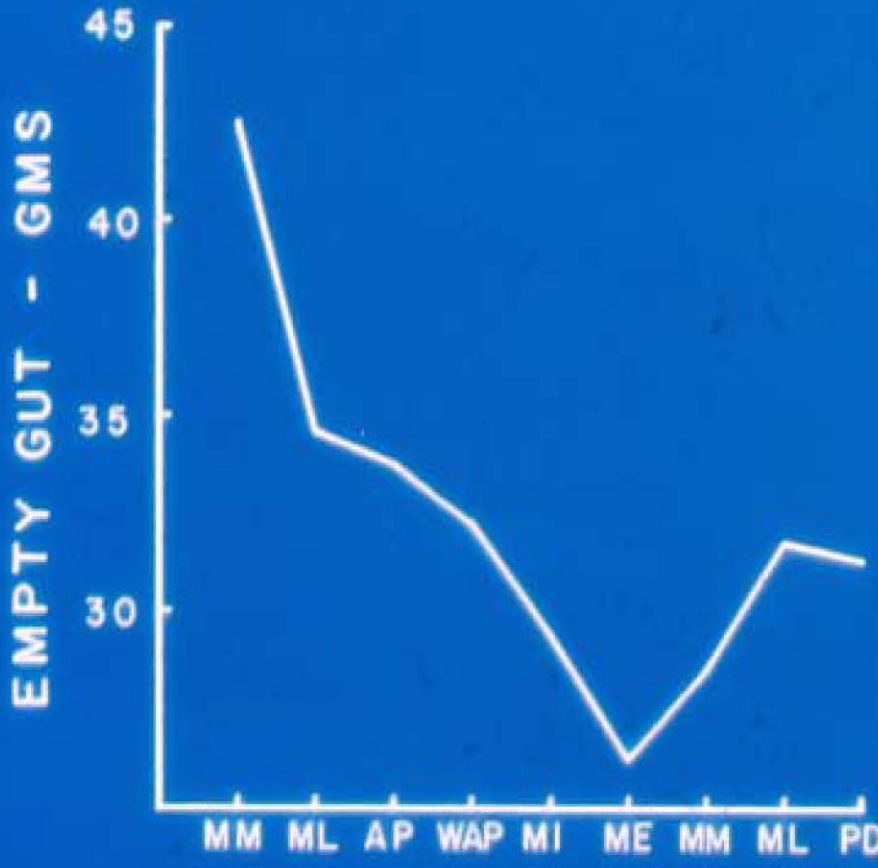
DOMINANCE RELATIONSHIPS

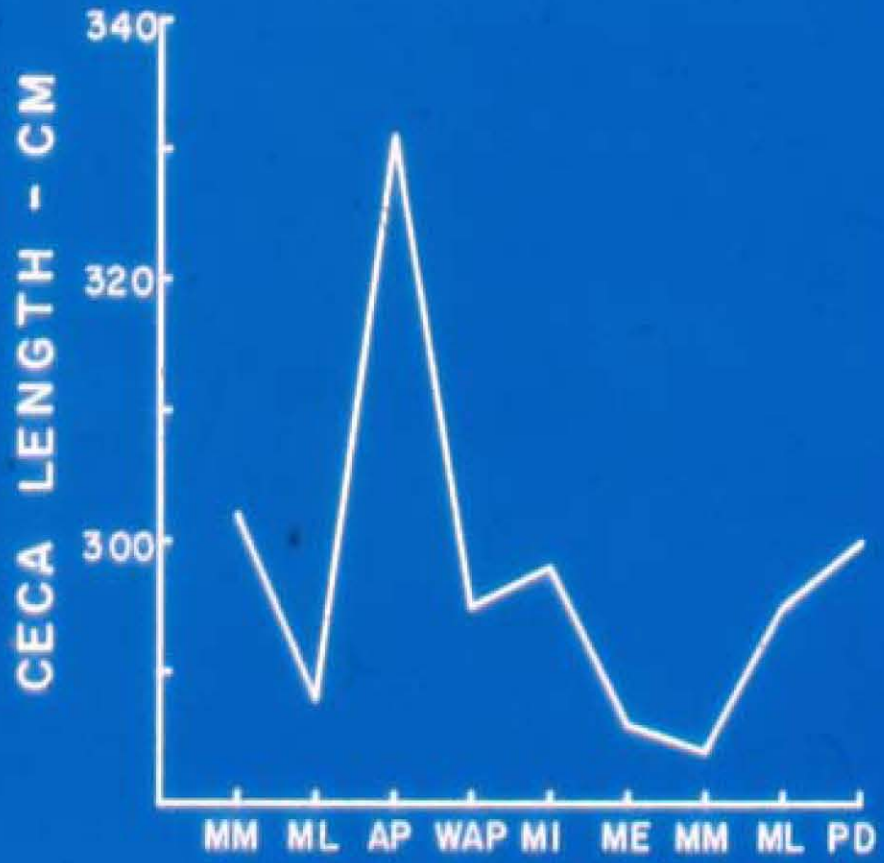
FEB - MAR 1982

FAT DEPOT	RANGE HIGH/LOW	EARLY MID MOLT % LOSS
RIGHT LEG	5.0	27
INTESTINE	7.9	52
PERITONEAL	9.3	49
SUBCUTANEOUS	7.7	34

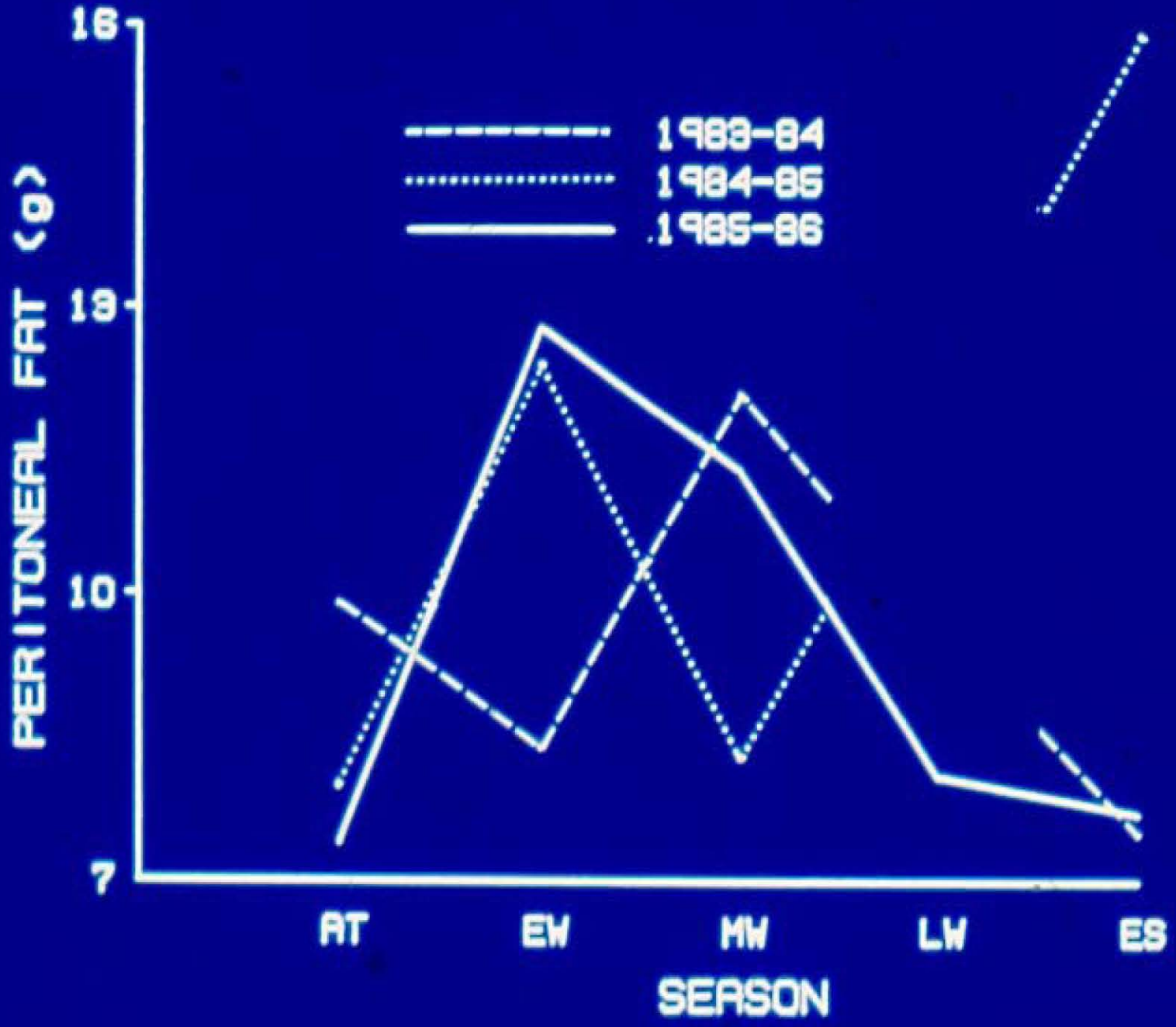

LIVER - GMS
30
28
26
24
22
MM ML AP WAP MI ME MM ML PD

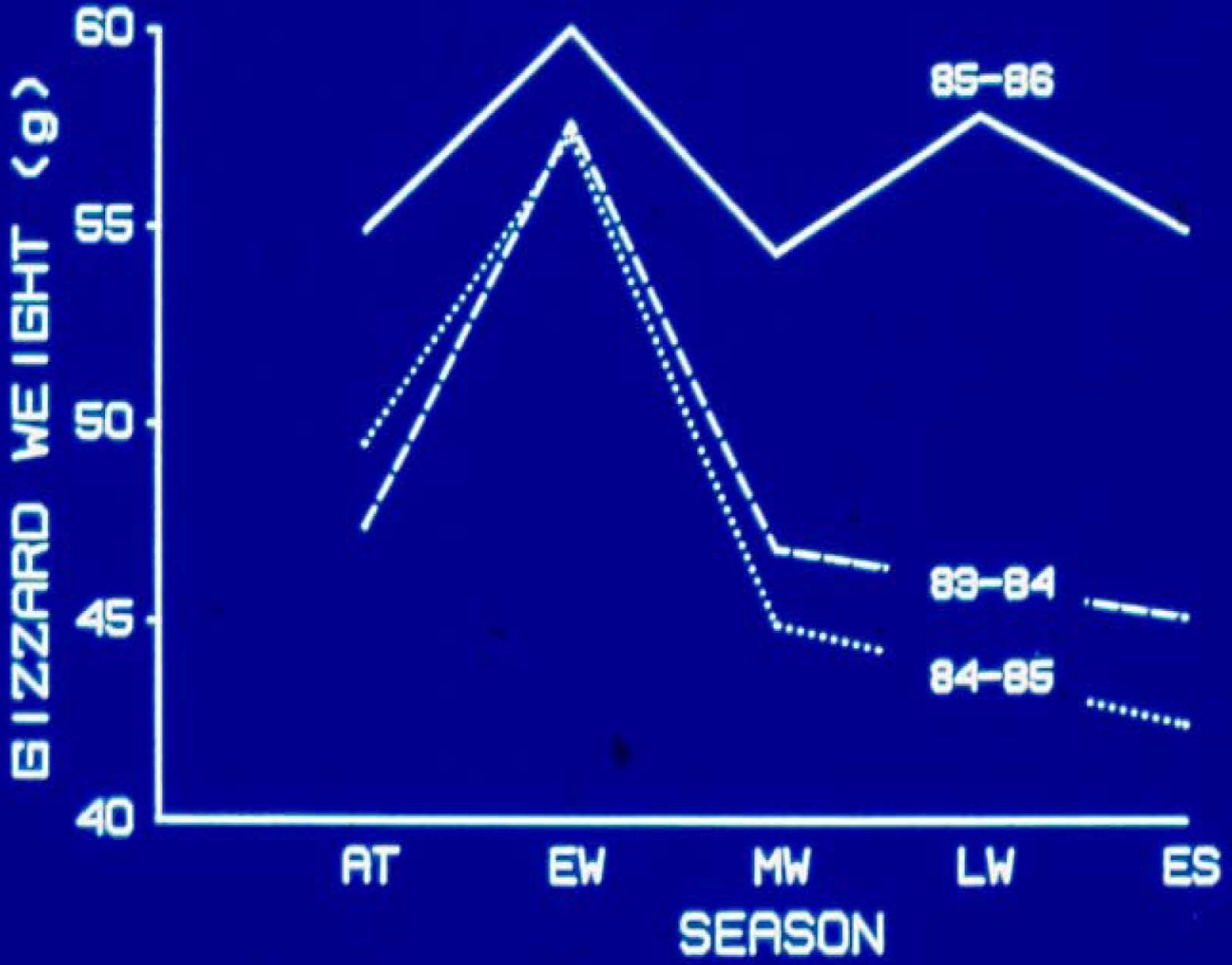

SPLEEN - GMS
1.2
1.0
0.8
0.6
MM ML AP WAP MI ME MM ML PD

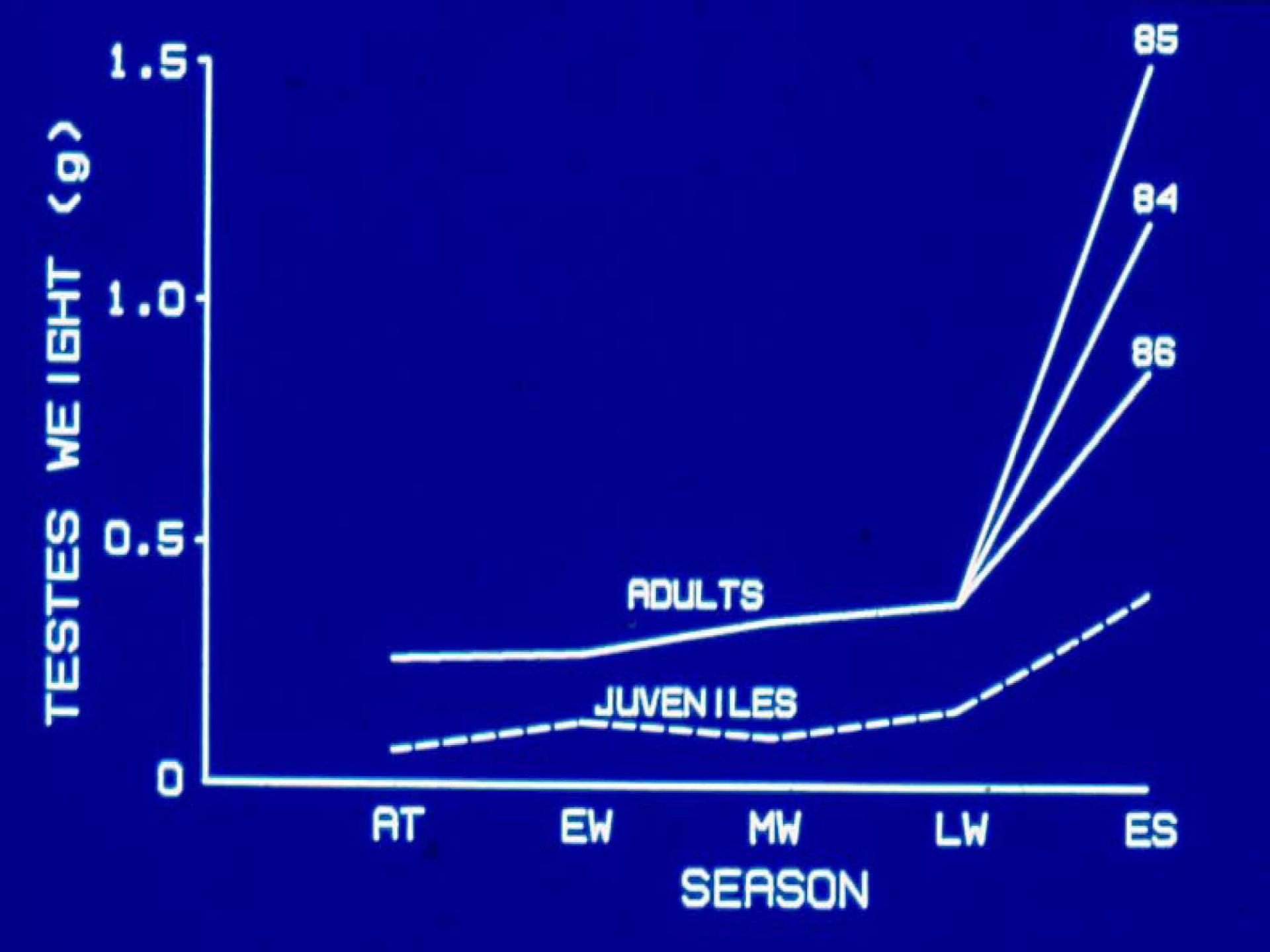

EMPTY GUT - GMS
45
40
35
30
MM ML AP WAP MI ME MM ML PD

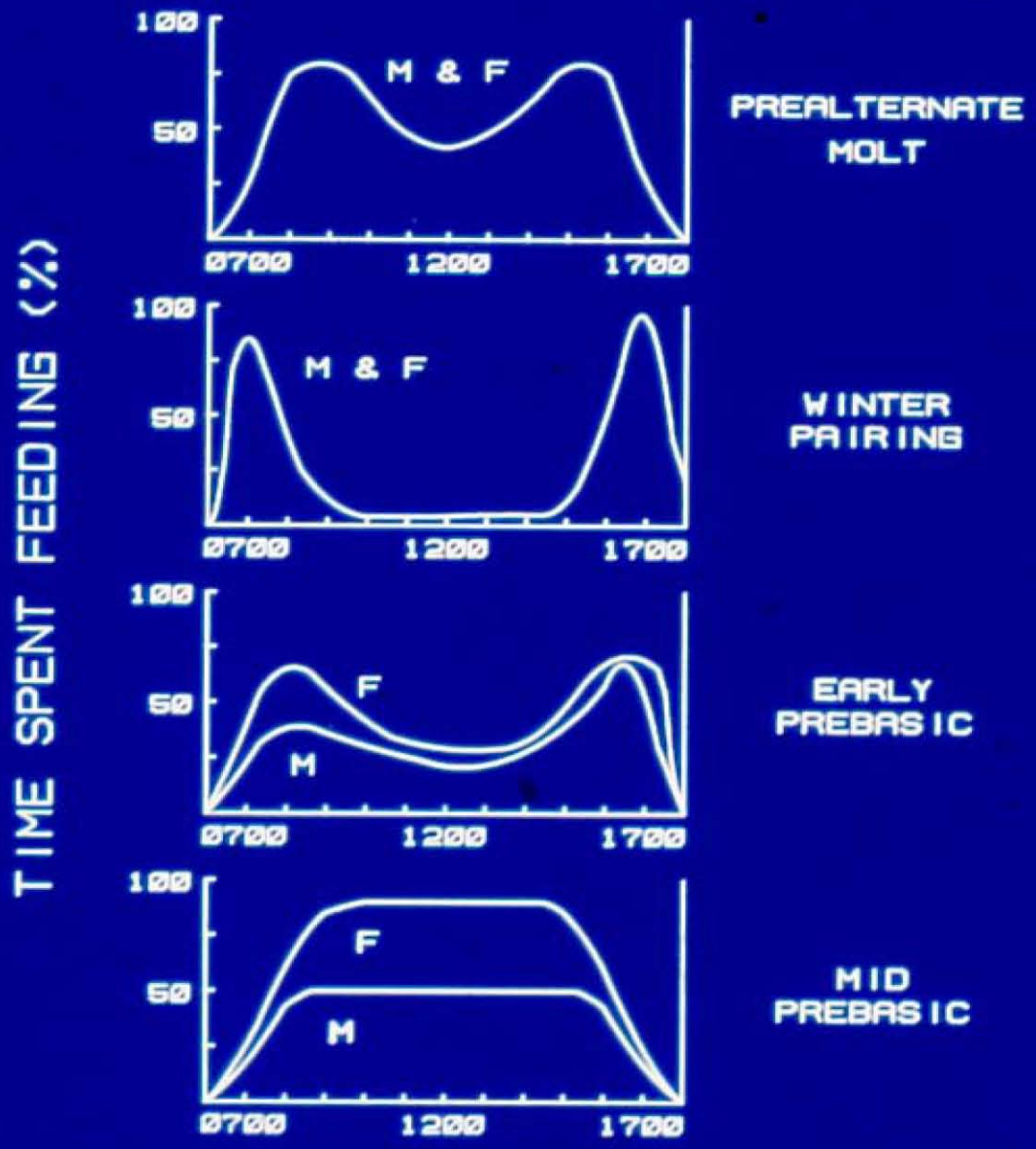

CECA LENGTH - CM
340
320
300
MM ML AP WAP MI ME MM ML PD

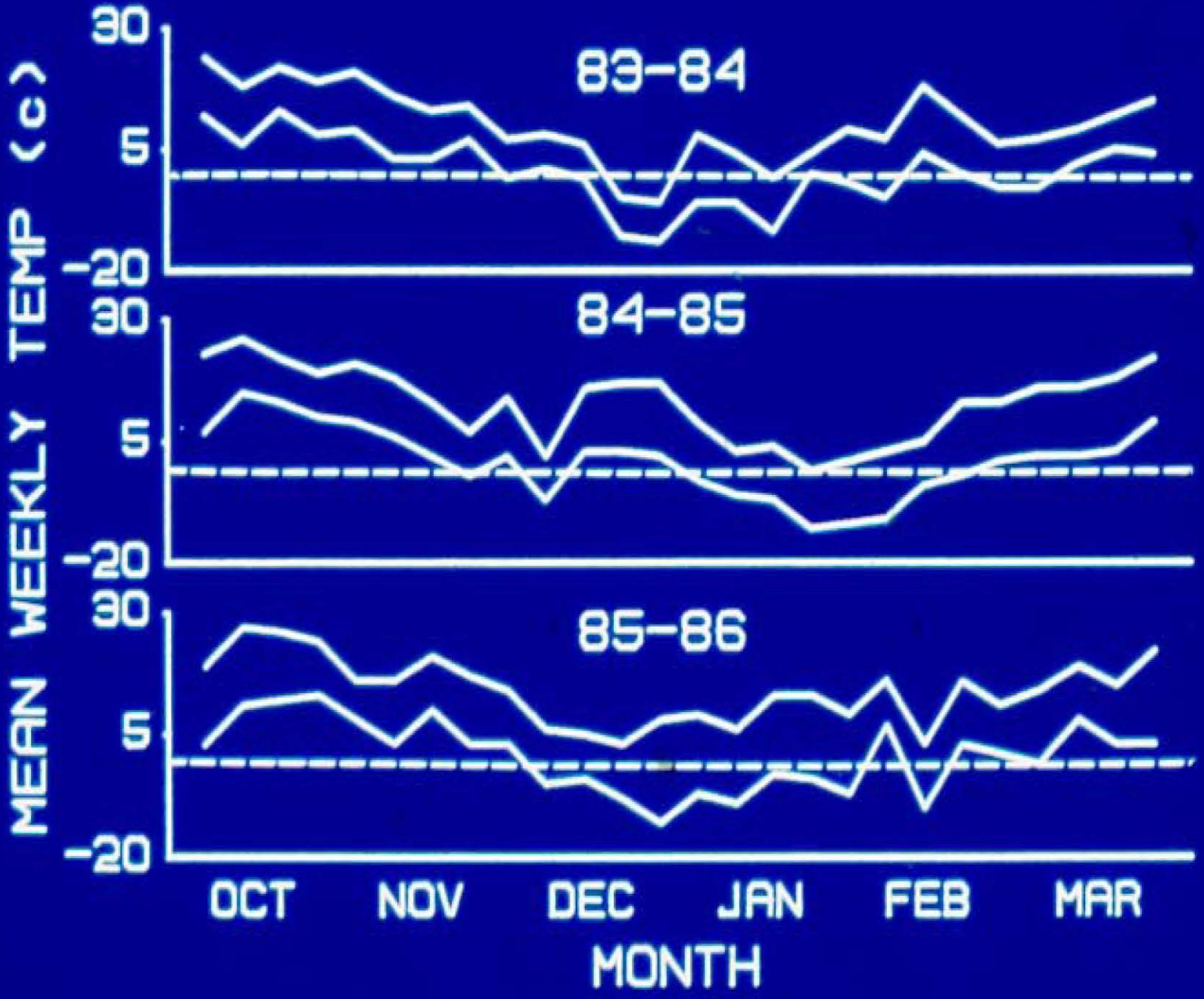

1400
1200
1000
ADULT
IMMATURE
PAIRED
UNPAIRED
BODY WEIGHT
85-86
OCT
NOV
DEC
JAN
FEB
MAR

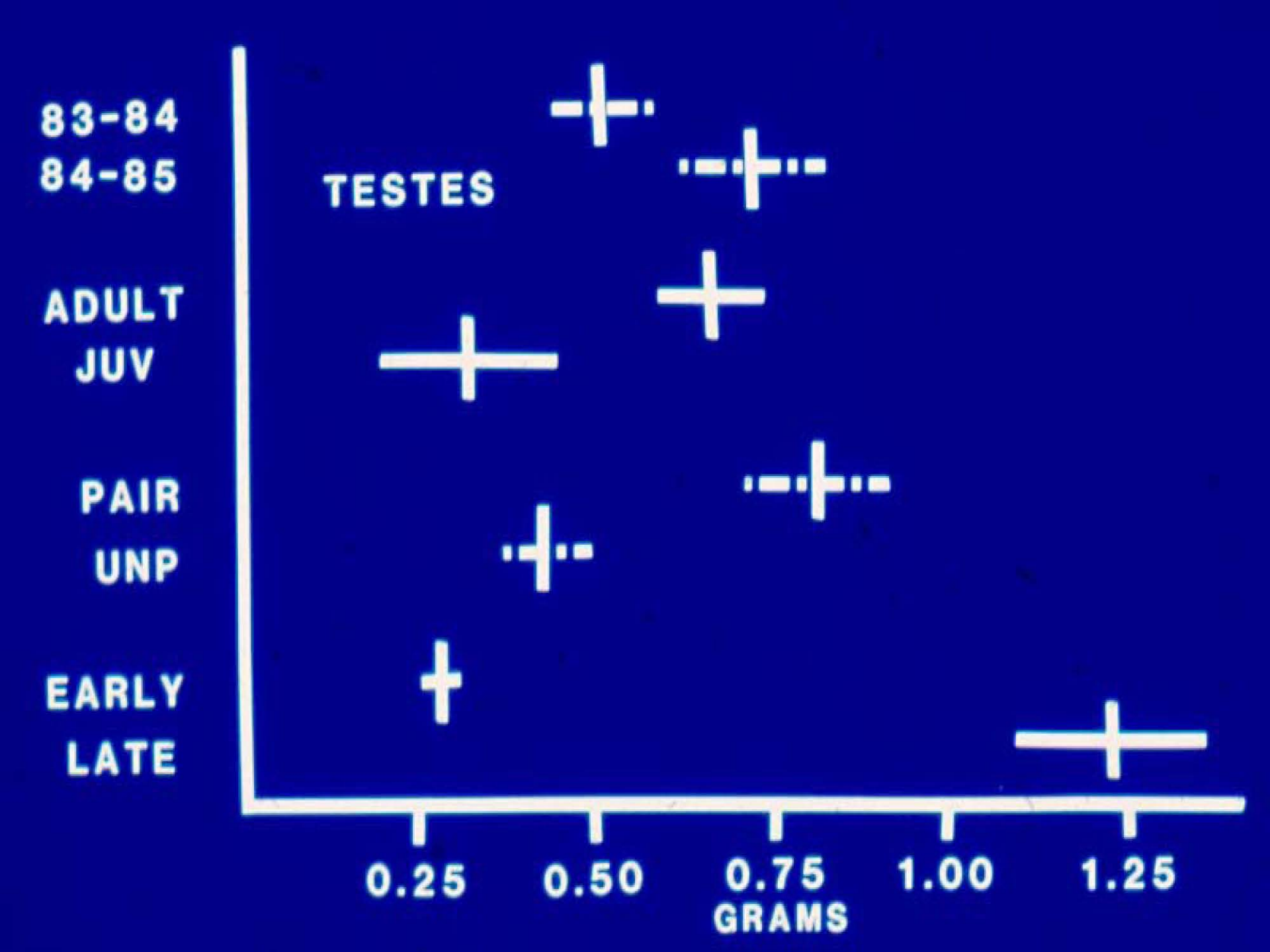

16
13
10
7
PERITONEAL FAT (g)
1983-84
1984-85
1985-86
AT
EW
MW
LW
ES
SEASON


GIZZARD WEIGHT (g)
60
55
50
45
40
85-86
83-84
84-85
AT
EW
MW
LW
ES
SEASON


TESTES WEIGHT (g)
1.5
1.0
0.5
0
85
84
86
ADULTS
JUVENILES
AT
EW
MW
LW
ES
SEASON


TIME SPENT FEEDING (%)
100
50
M & F
0700
1200
1700
PREALTERNATE MOLT
100
50
M & F
0700
1200
1700
WINTER PAIRING
100
50
F
M
0700
1200
1700
EARLY PREBASIC
100
50
F
M
0700
1200
1700
MID PREBASIC


MEAN WEEKLY TEMP (c)
30
5
-20
83-84
84-85
85-86
OCT
NOV
DEC
JAN
FEB
MAR
MONTH


83-84
84-85
TESTES
ADULT
JUV
PAIR
UNP
EARLY
LATE
0.25
0.50
0.75
1.00
1.25
GRAMS

Annual Cycle Events

Migration

Reproduction (Pre-Laying, Egg Laying, Incubation, Brood Rearing)

Molt

Postbreeding Dispersal

Staging

Migration

Pairing

Molt

Reserve Deposition

Estimated Days to Replenish Fat Reserves Related to Migration Distance and Habitat Condition/Disturbance (Fredrickson and Drobney 1977)

Flight Time	Distance	480 Kcal	390 Kcal
2 hours	128 km	0.8 days	1.7 days
6 hours	384 km	2.3 days	5.2 days
10 hours	640 km	3.8 days	8.6 days
14 hours	895 km	5.3 days	12.1 days

Benefits of Favorable Winter Water (Habitat) Conditions (Heitmeyer 1985, 1988, Reinecke et al. 1989)

- Improved Foraging Opportunities
- Better Physical Condition
- Earlier Completion of Annual Events
- Wider Distribution
- Increased Survival and Reproduction

BREEDING DUCK STRATEGIES: CAVITY AND PRAIRIE NESTING WATERFOWL

FACTORS INFLUENCING RECRUITMENT

- AGE AT FIRST BREEDING
- LONGEVITY
- OCCURRENCE OF BREEDING (NUMBER OF NESTS ANNUALLY)
- NEST SUCCESS
- HATCHING SUCCESS
- BROOD SURVIVAL

BREEDING PROPENSITY

PROPORTION OF BIRDS THAT ATTEMPT TO BREED IS DETERMINED BY:

- Age at what waterfowl become capable of breeding,
- Occurrence of breeding among sexually matured birds.

AGE AT FIRST BREEDING:

Most dabbling ducks and some diving ducks breed as yearlings

Most diving ducks breed as 1-yr or 2-yr-olds or sometimes as 3-yr-olds

Sea ducks, mergansers and geese usually breed when 2-yr or 3-yr-old

Swans mostly breed at 3 years or older

Occurrence of breeding among sexually matured birds

- Breeding
- Renesting
- Double-brooding
- Non-breeding

NON-BREEDING:

- VERY DIFFICULT TO ESTIMATE and PUBLISHED VALUES OFTEN ARE MISLEADING
- YOUNGER AGE CLASSES IN CROWDED SITUATIONS
- POOR HABITAT QUALITY (drought conditions in prairie, parkland, and Southern swamp habitat)
- POOR BODY CONDITION

PRAIRIE NESTING DABBLING DUCKS

- IN GRASSLANDS SURROUNDING WETLANDS (MALLARDS MORE FLEXIBLE)
- ADAPTED TO VARIOUS DEGREES OF COVER
- FEW EXTENSIVE AREAS OF HABITAT REMAINING
- PREDATORS HAVE AN ADVANTAGE

COVER

- DENSE/TALL - MALLARD, GADWALL
- SPARSE/LOW – PINTAIL, BLUE-WINGED TEAL
- BRUSHY – GREEN-WINGED TEAL

DISTANCE TO WETLAND

- NEAR – BLUE-WING, SHOVELER, CINNAMON TEAL
- DISTANT – PINTAIL
- VARIABLE – MALLARD, GADWALL

TYPE OF WETLAND

- TEMPORARY/SEASONAL – PINTAIL, BLUE-WINGED TEAL
- SEMIPERMANENT – BLUE-WING, SHOVELER, GADWALL
- MORE VARIABLE - MALLARD

TIMING OF NESTING WITH FOOD

- EARLY NESTING
  - MALLARD/PINTAIL
    - ADULTS - FAIRY SHRIMP AND EARTHWORMS
    - YOUNG - TAKE ADVANTAGE OF AQUATIC INSECTS
- LATE NESTING
  - RUDDY DUCK
    - ADULTS – ABUNDANCE OF BLOODWORMS

CAVITY NESTING WATERFOWL

- WHY?? SPRING FLOODING INUNDATES GOOD GROUND NESTING SITES AND/OR THESE SITES SUBJECT TO HEAVY PREDATION

CAVITY NESTING WATERFOWL

- WHY?? SPRING FLOODING INUNDATES GOOD GROUND NESTING SITES AND/OR THESE SITES SUBJECT TO HEAVY PREDATION
- Different strategies by tribes with first breeding at 1 or 2 years of Age (Cairinini vs Mergini)

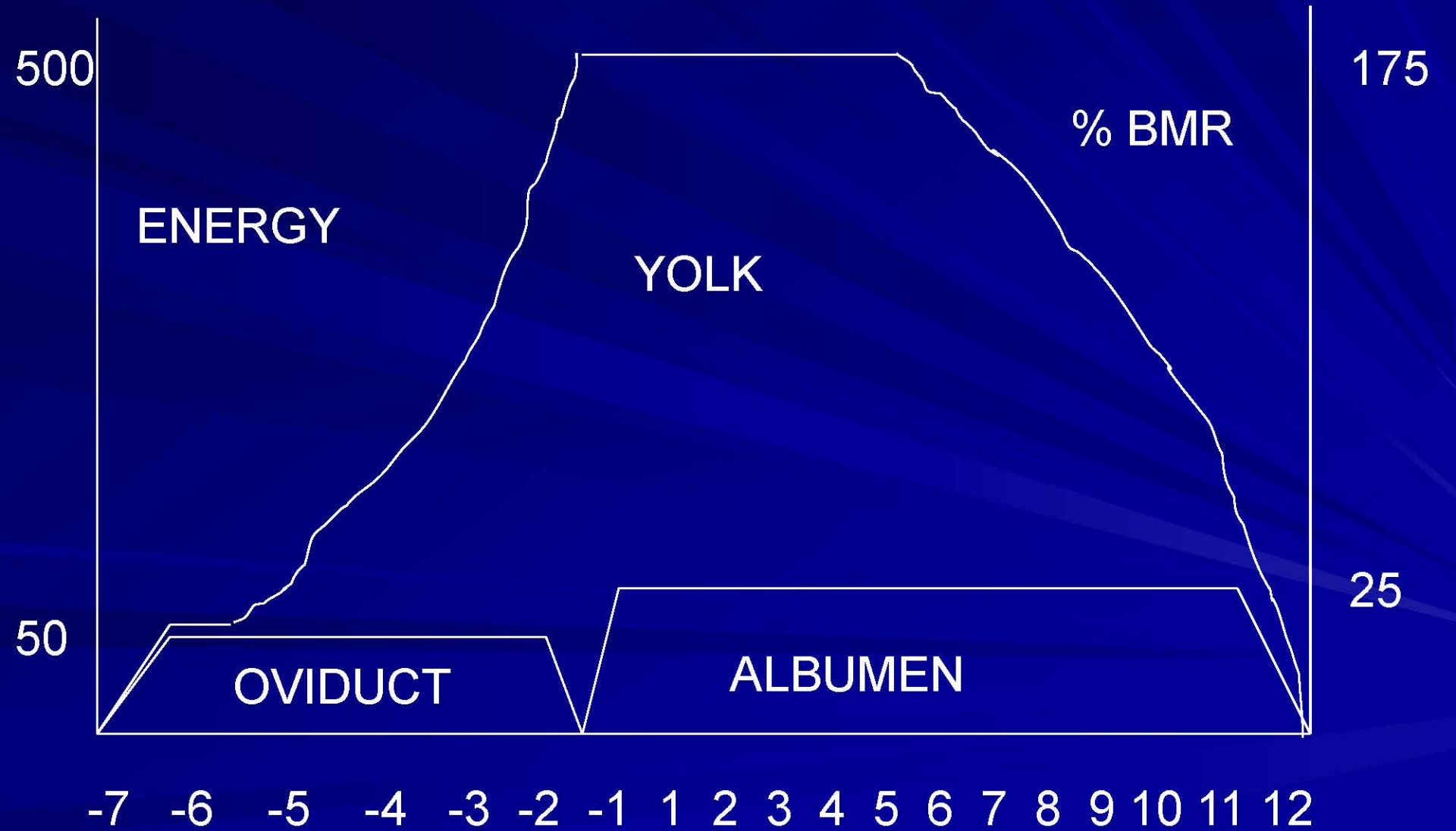
SPRING WOOD DUCK FORAGING (PERCENT)

FEEDING MODE	MALES	FEMALES
PECKING ON SURFACE	75	58
SURFACE DABBLING	18	23
SUBSURFACE DABBLING	6	15
BOTTOM FEEDING	4	3

FOODS CONSUMED BY WOOD DUCKS

STATUS AND GENDER	PERCENT ANIMAL
PRELAYING FEMALE	54
LAYING FEMALE	79
POSTLAYING FEMALE	43
BREEDING MALE	34
FALL FEMALE	33
FALL MALE	36

DAILY ENERGY REQUIREMENTS



HOW DO THESE FEMALES DO THIS

- INTENSIVE FORAGING
- 8 HOURS/DAILY
- NEED ABOUT 4.5 GRAMS PROTEIN
- NEED ABOUT 500 BUGS/HOUR TO BE SUCCESSFUL OR OVER 4000 BUGS/DAY

INTERESTING FACTS FROM MINGO SWAMP STUDY

- A population cannot be moved but must be established.
- There is habitat imprinting.
- Visual cues are used to find cavities.
- Attentiveness is highly variable among hens.
- Many yearling hens lay partial cluthes of eggs but do not incubate.

INTERESTING FACTS FROM MINGO SWAMP STUDY

- A SMALL NUMBER OF WOOD DUCK HENS PRODUCE MOST OF THE RETURNING OFFSPRING
  - I CALL THEM SUPER FEMALES
  - THEIR DUCKLINGS HAVE HIGHER SURVIVAL RATES
  - IN A CLUTCH OF 12 THEY MAY HAVE 2 OR MORE RETURNING FEMALE OFFSPRING

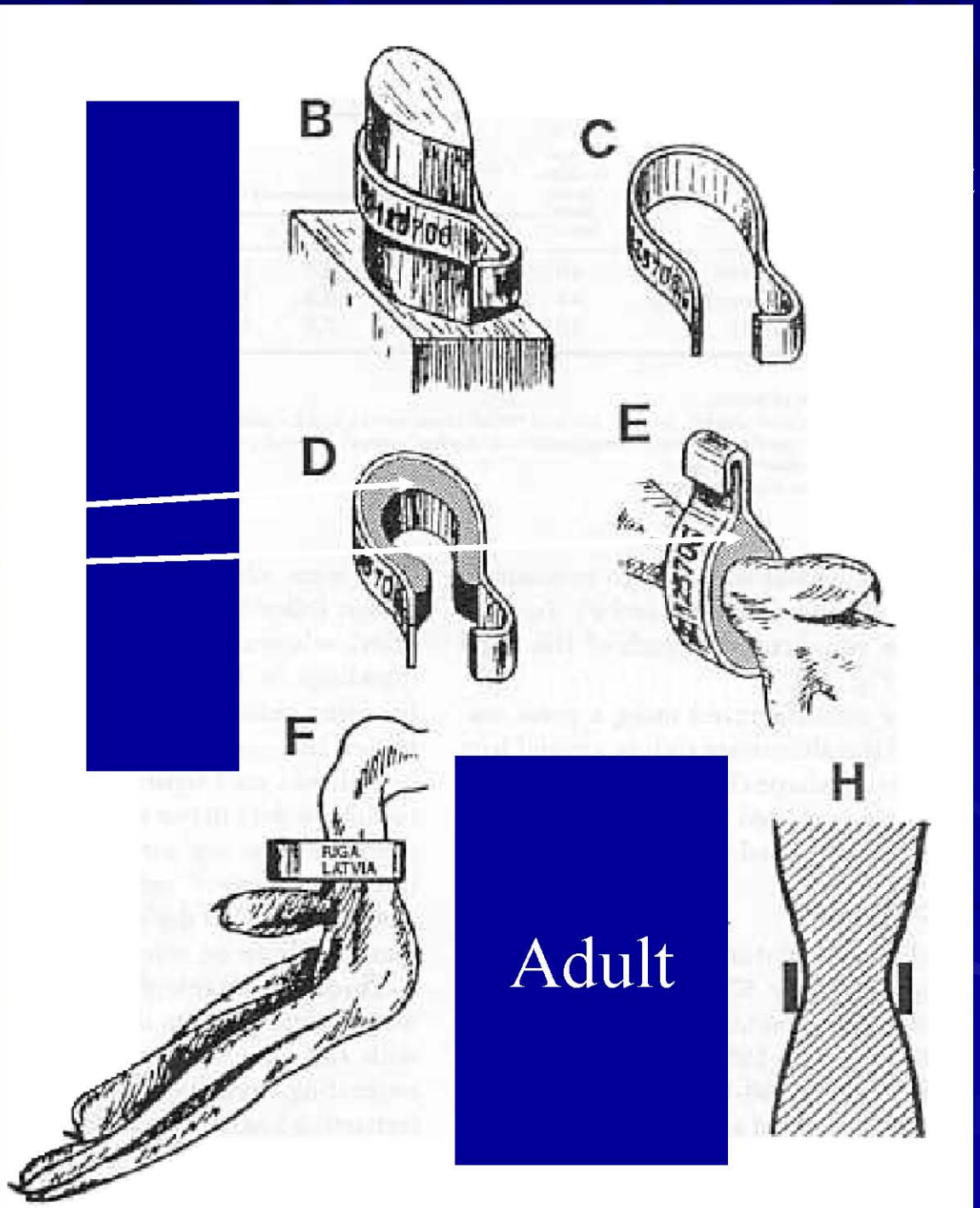
THESE SUPER FEMALES

- TEND TO NEST ABOUT THE SAME TIME ANNUALLY
- HAVE VERY PRECISE HOMING TO THE SAME BOX
- HAVE UNIFORM CLUTCH SIZES AMONG YEARS
- ALWAYS HAVE A SERIES OF INDICATORS THAT THEY HAVE GOOD NESTING CHARACTERISTICS

Plasticine-filled oval leg bands: a new banding technique for day-old ducklings

Stainless steel plasticine-filled oval leg bands used on day-old ducklings in North America since 1998

Plasticine liner




Day-old HM duckling
fitted with plasticine-filled leg band

Day-old ducklings banded (1998-2004) with toll-free duckling bands and recoveries reported by 10 Sep 2003

Species	Day-old ducklings banded	Hunting recoveries	Long-distance natal dispersal recoveries
WD	8265	328 (5.6%)*	15 (4.6%)
HM	3417	130 (5.7%)*	33 (25.0%)
Total	11682	458 (5.7%)*	

*percent recoveries from all

LONG-DISTANCE (>500 km) NATAL DISPERSAL MOVEMENTS OF HOODED MERGANSERS AND WOOD DUCKS REVEALED BY LARGE SCALE BANDING OF DAY-OLD DUCKLINGS IN MINGO SWAMP, MISSOURI

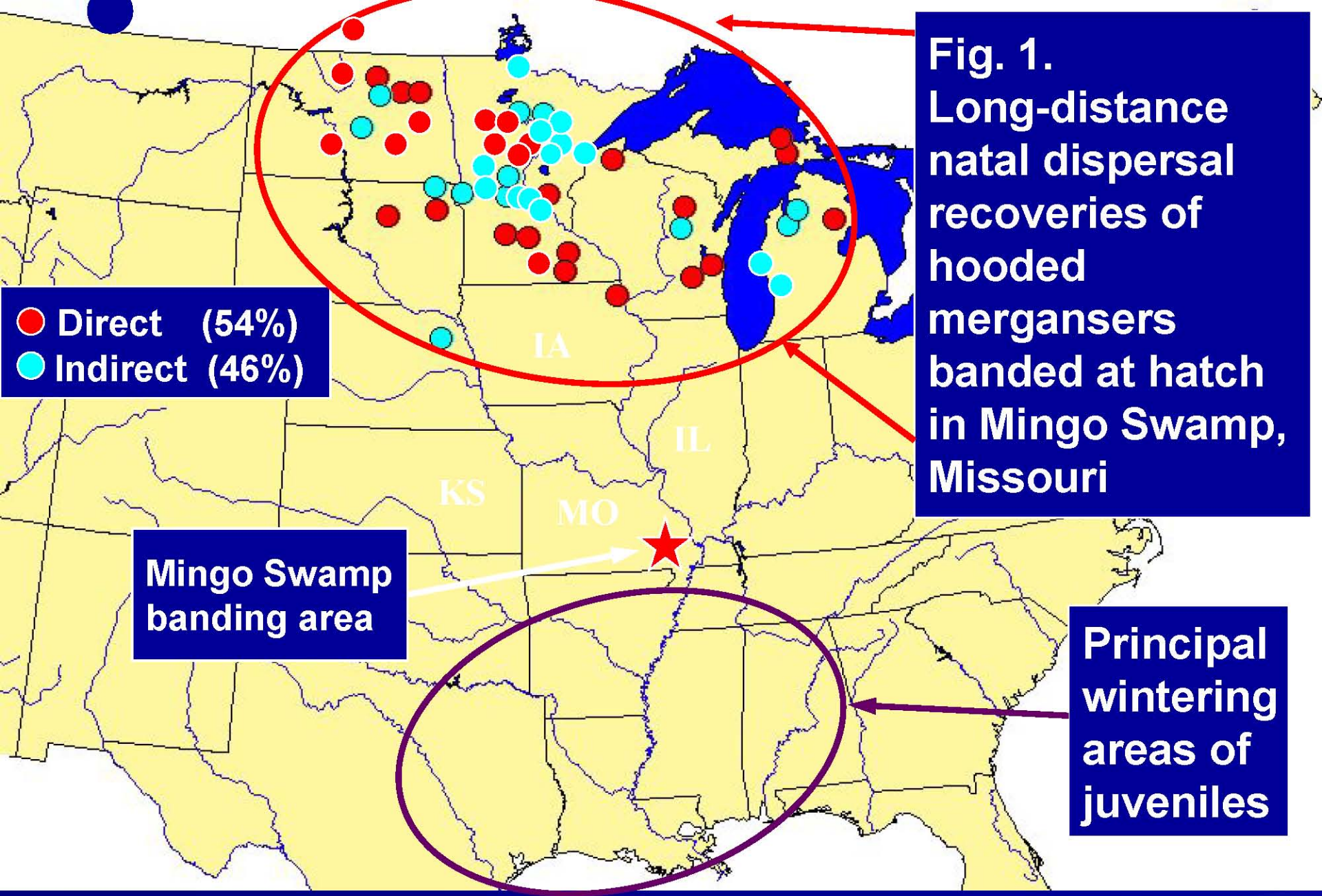
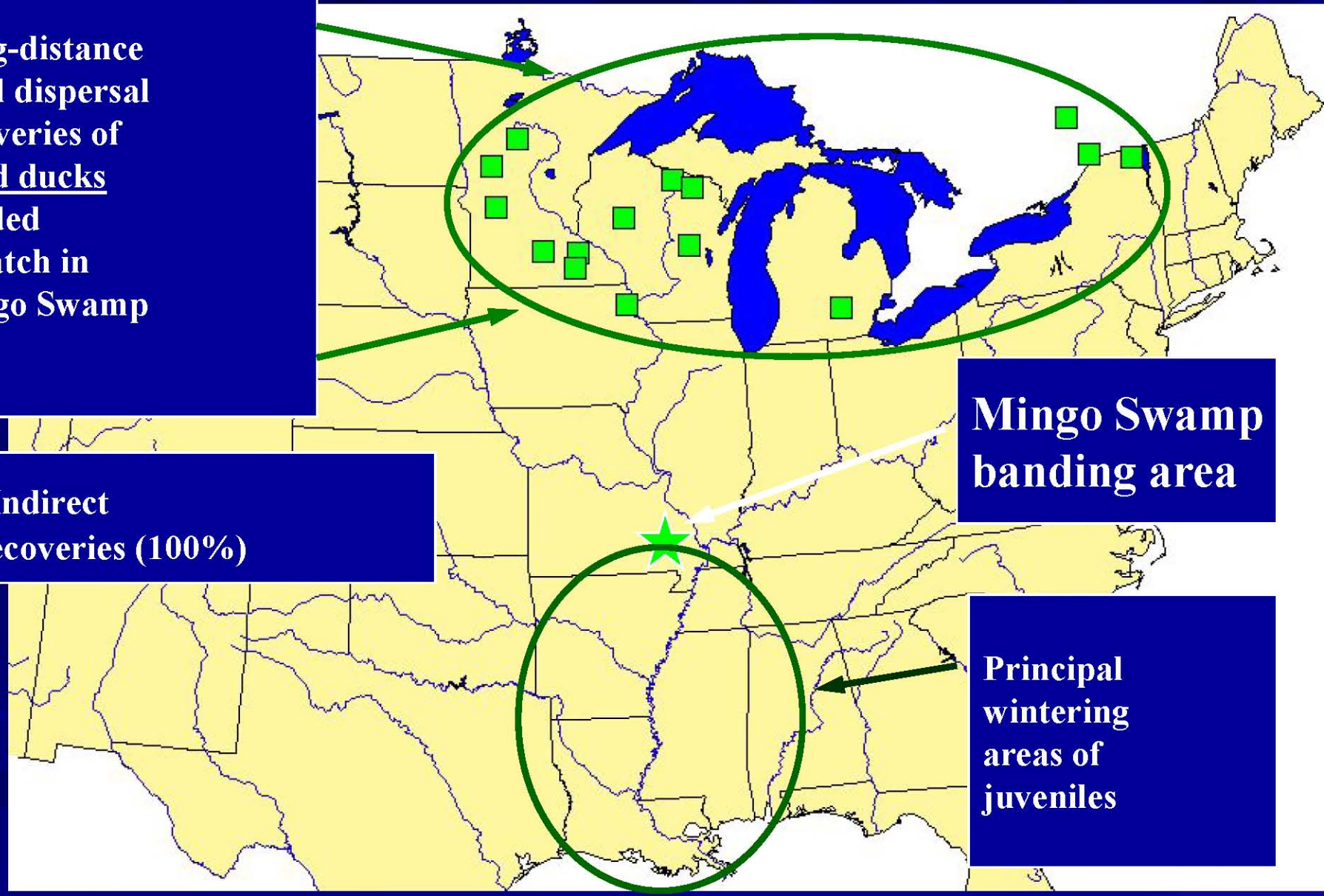


Fig. 1. Long-distance natal dispersal recoveries of hooded mergansers banded at hatch in Mingo Swamp, Missouri

LONG-DISTANCE (>500 km) NATAL DISPERSAL MOVEMENTS OF HOODED MERGANSERS AND WOOD DUCKS REVEALED BY LARGE SCALE BANDING OF DAY-OLD DUCKLINGS IN MINGO SWAMP, MISSOURI

Long-distance natal dispersal recoveries of wood ducks banded at hatch in Mingo Swamp



Mingo Swamp banding area

Indirect recoveries (100%)

Principal wintering areas of juveniles

WATERFOWL WITH DELAYED MATURITY, SUCH AS HOODED MERGANSERS AND COMMON GOLDENEYES, BEGIN NESTING WHEN THEY ARE AT LEAST 2-YEAR-OLD.

FEMALES OF THESE SPECIES NEVER NEST AS YEARLINGS.

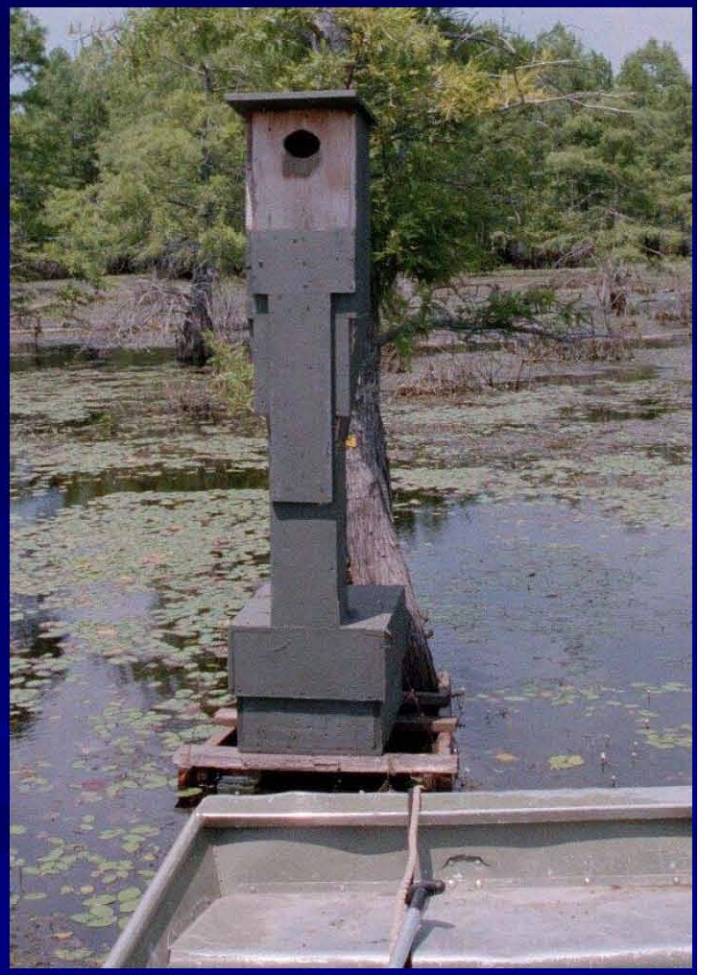
WHAT DO WE KNOW ABOUT MOVEMNTS AND BEHAVIOR OF THESE SPECIES DURING THE PERIOD BETWEEN THE HATCHING DATE AND FIRST NESTING ???

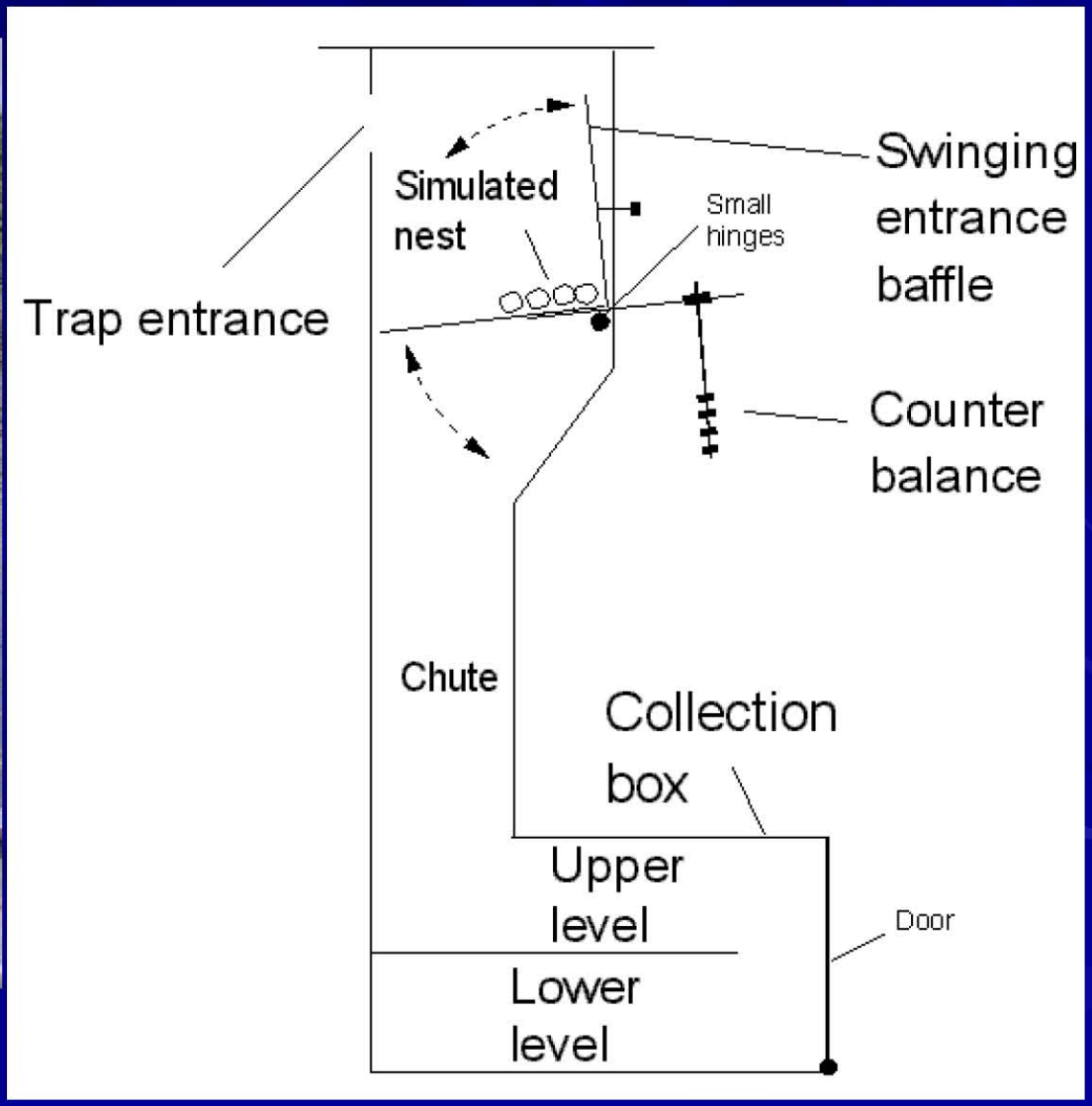
To get some insight about the behavior of these species during the 2-year period prior to first nesting we developed automatic multi-capture nest box traps that captured prospecting non-breeding females

Automatic multi-capture nest box traps: a new capture technique for prospecting females of cavity-nesting ducks

Automatic multi-capture nest box trap

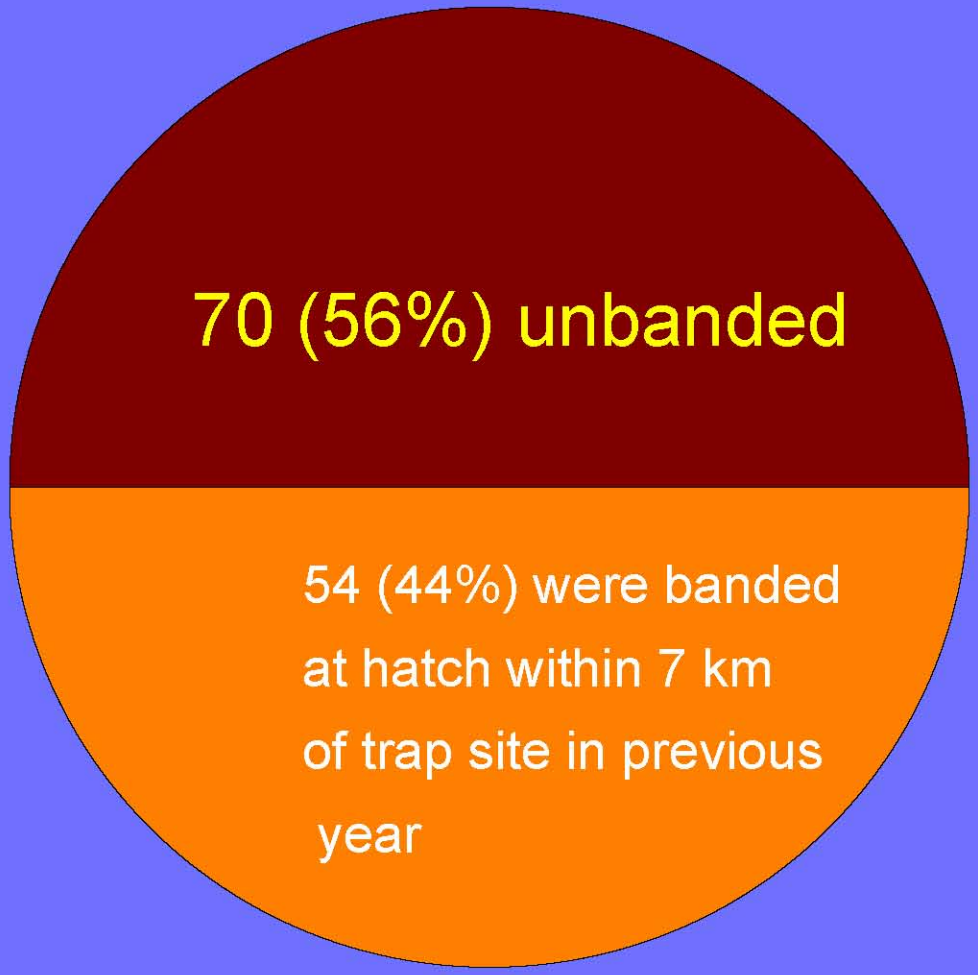
7-10 days at 1 site





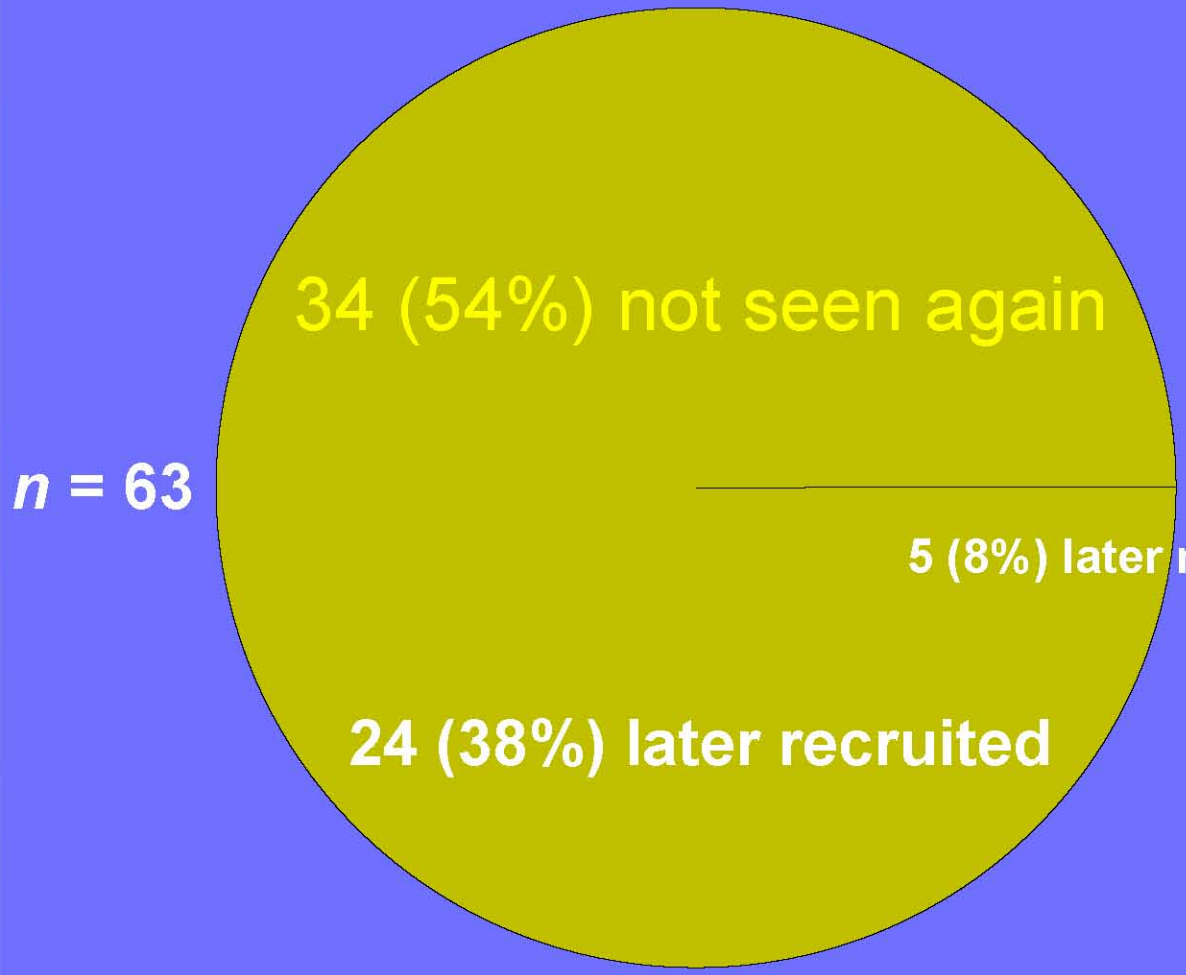
Automatic multi-capture nest box trap

Homing of yearling female hooded mergansers to natal areas (1999-2003) (124 yearlings captured in multi-capture traps)



n = 124

Fate of 63 yearling female hooded mergansers captured in multi-capture traps during 1999-2001



Most cavity nesting waterfowl with delayed maturity probably return to their natal wetlands as yearlings and then emigrate or stay depending on local habitat conditions and population density