EVALUATION OF THE RELATIONSHIP BETWEEN ACTIVE PURSE-SEINE FISHING CAPACITY AND FISHING MORTALITY IN THE EASTERN PACIFIC OCEAN

Mark Maunder

and

Richard Deriso

Introduction

- Limits the total capacity of the purse-seine fleet as a management measure to control effort.
- Temporal closures (and a small spatial closure) to control fishing effort
- Attempt to keep fishing mortality at or below levels that correspond to the maximum sustainable yield (MSY).
- Capacity limits do not specify what type of purse-seine set (on floating objects, on yellowfin tuna associated with dolphins, and on unassociated schools) the vessels can make
- Vessels that set on yellowfin associated with dolphins are required to have a dolphin mortality limit (DML).
- We correlate estimates of fishing mortality from the yellowfin and bigeye tuna stock assessments with the capacity limits to evaluate how effective the capacity limits are at controlling effort.

Estimating fishing mortality

$$U_y = \frac{C_y}{B_y}$$

$$B_y = \frac{\sum_{q,a} N_{y,q,a} s_a}{4}$$

$$\acute{s_a} = \frac{\sum_g s_{g,a} \sum_{y,q} C_{g,y,q}}{\sum_{g,y,q} C_{g,y,q}}$$

$$s_a = \frac{\acute{s}_a}{\max(\acute{s})}$$

$$C_y = \sum_{g',q} C_{g,y,q}$$

Effective capacity

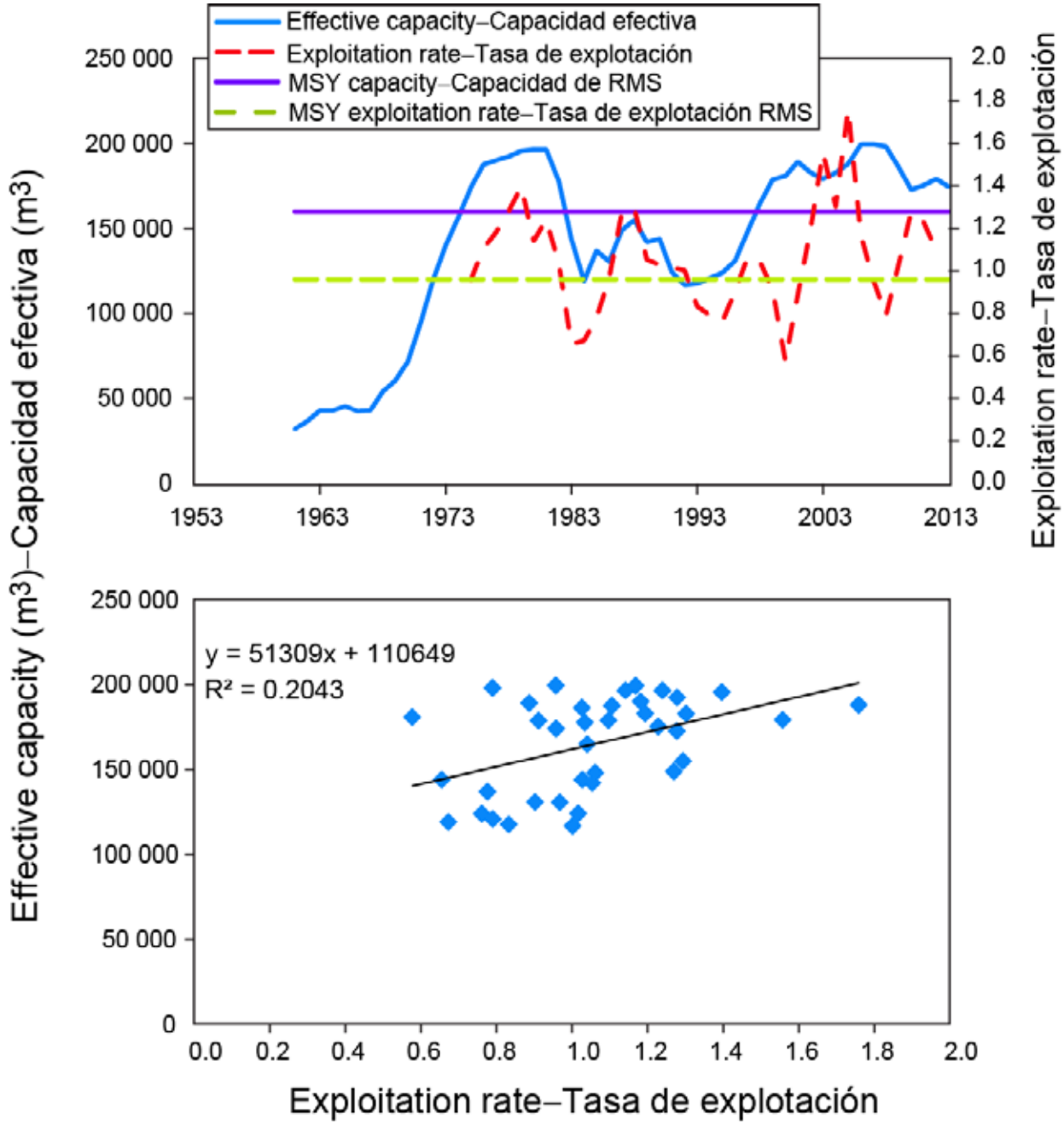
The effective capacity (E'_y) is calculated by adjusting the active capacity by the amount of time the fishery is not closed:

$$E'_y = E_y * O_y$$

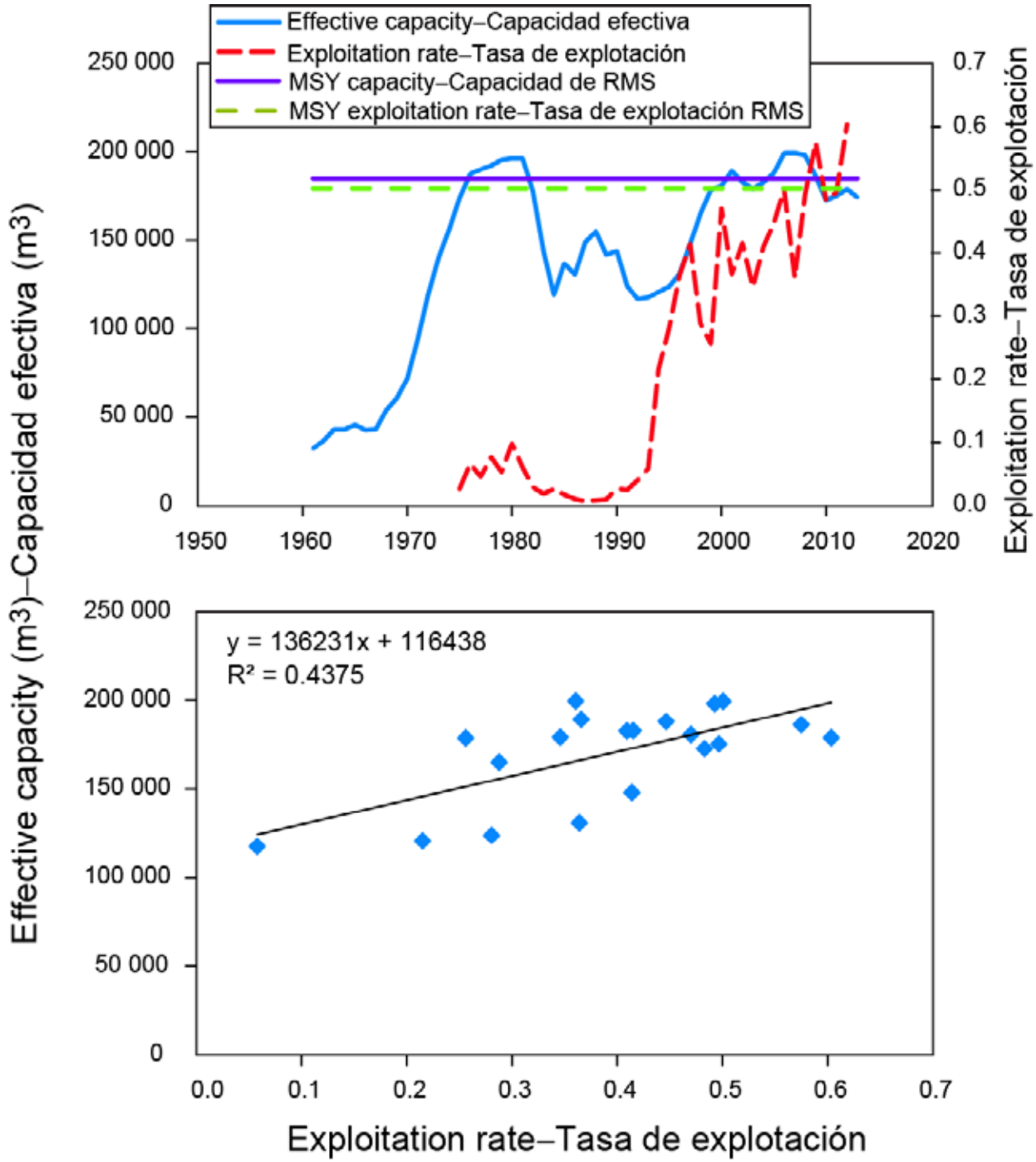
where *E* is the active purse-seine capacity in the EPO and *O* is the proportion of the year that the fishery is open.

The exploitation rate associated with MSY was converted into capacity by using the regression of effective capacity on relative combined exploitation rate.

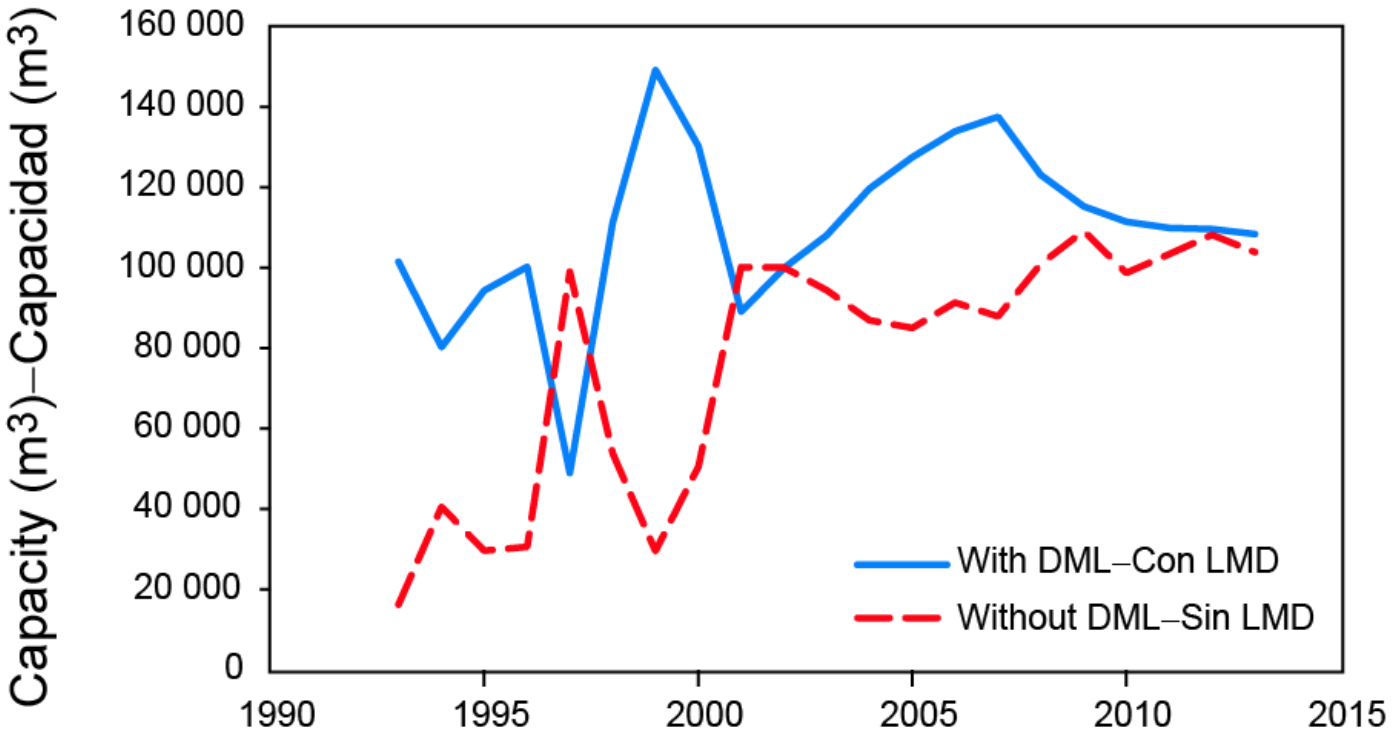
Yellowfin


Effective capacity–Capacidad efectiva
Exploitation rate–Tasa de explotación
MSY capacity–Capacidad de RMS
MSY exploitation rate–Tasa de explotación RMS
Effective capacity (m3)–Capacidad efectiva (m3)
Exploitation rate–Tasa de explotación
250 000
200 000
150 000
100 000
50 000
0
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1953
1963
1973
1983
1993
2003
2013
y = 51309x + 110649
R² = 0.2043
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
Exploitation rate–Tasa de explotación

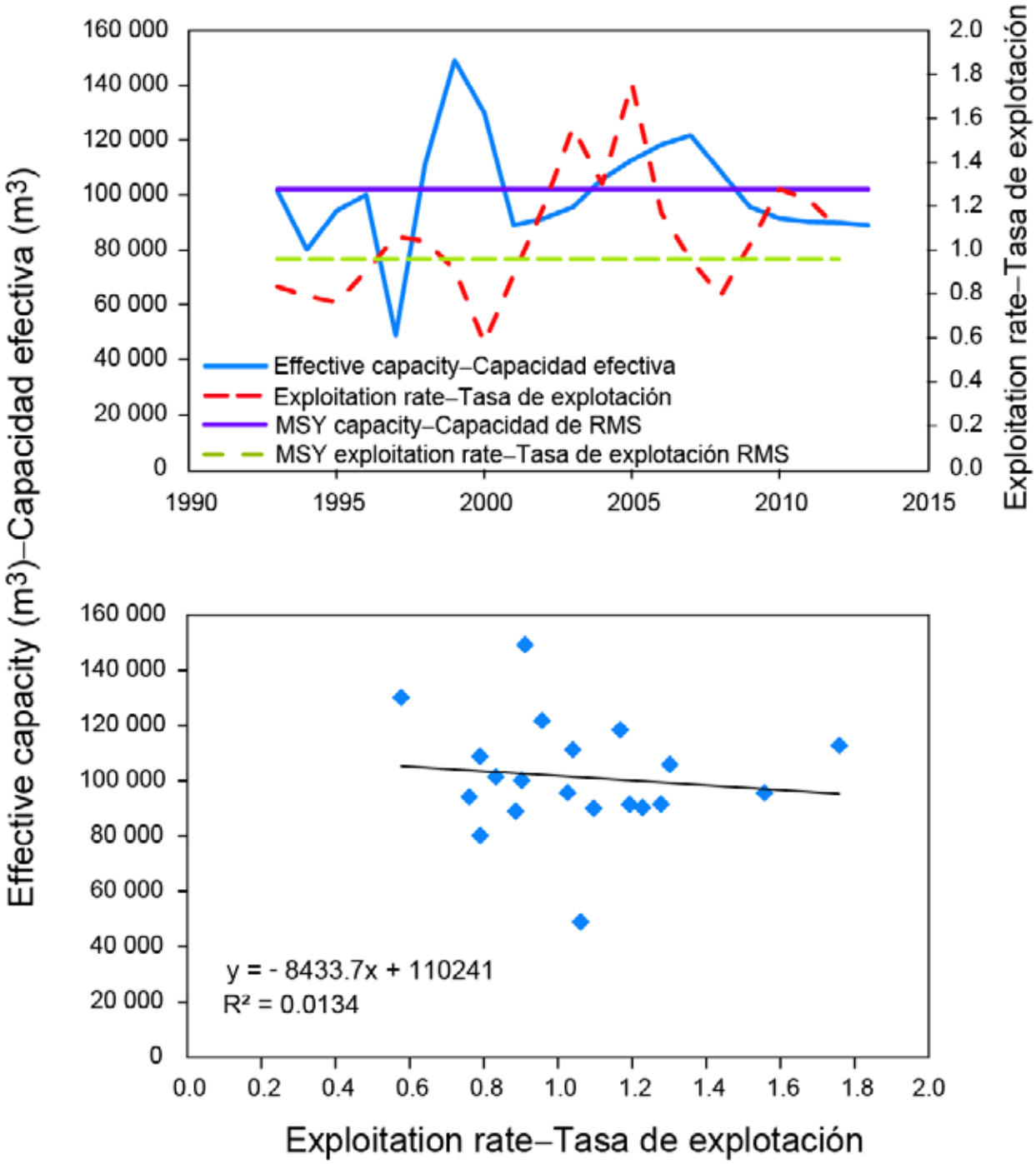
Bigeye


Effective capacity–Capacidad efectiva
Exploitation rate–Tasa de explotación
MSY capacity–Capacidad de RMS
MSY exploitation rate–Tasa de explotación RMS
250 000
200 000
150 000
100 000
50 000
0
1950
1960
1970
1980
1990
2000
2010
2020
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Exploitation rate–Tasa de explotación
y = 136231x + 116438
R² = 0.4375
Effective capacity (m³)–Capacidad efectiva (m³)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Exploitation rate–Tasa de explotación

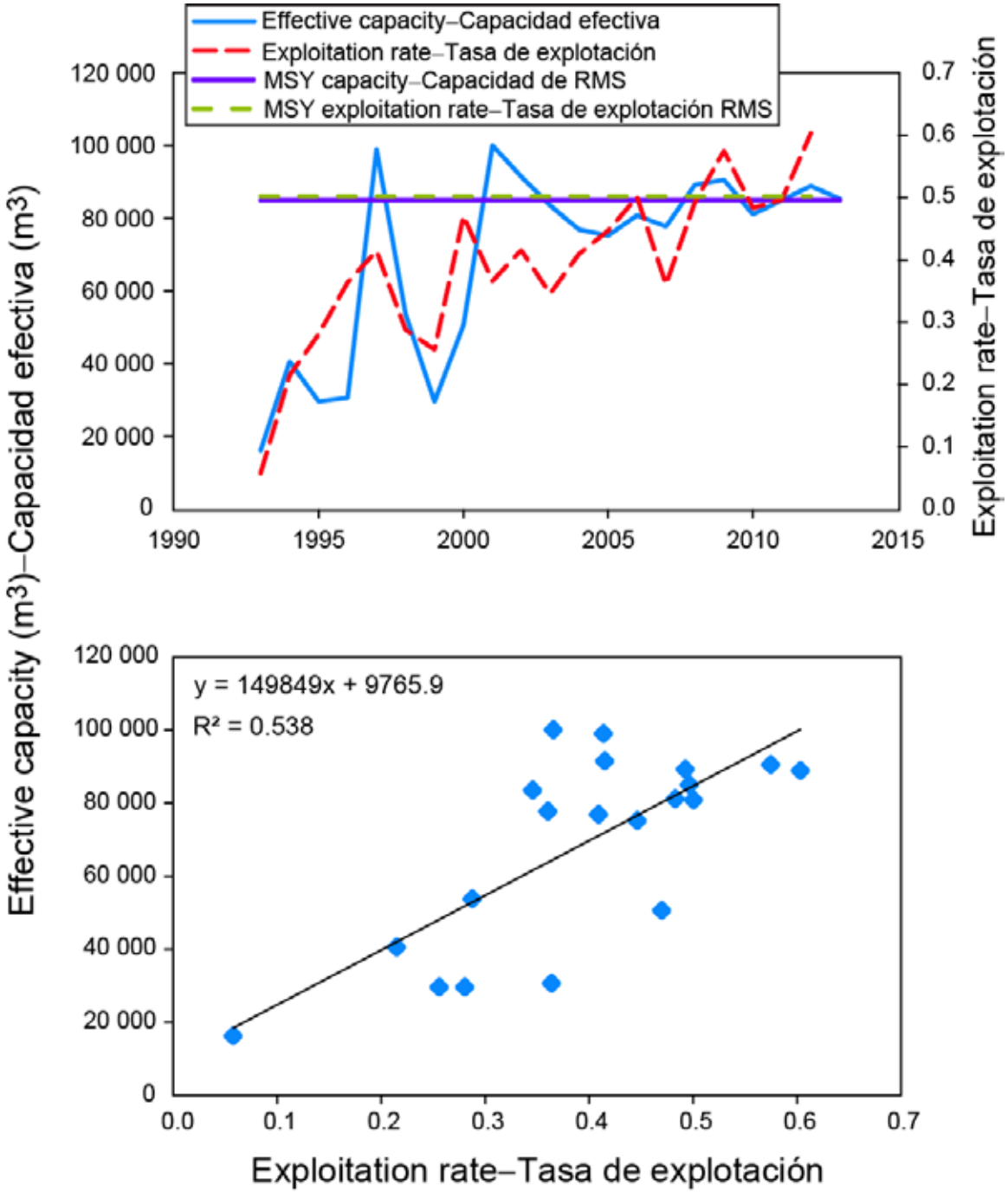
Dolphin targeting based on DML



Yellowfin DML

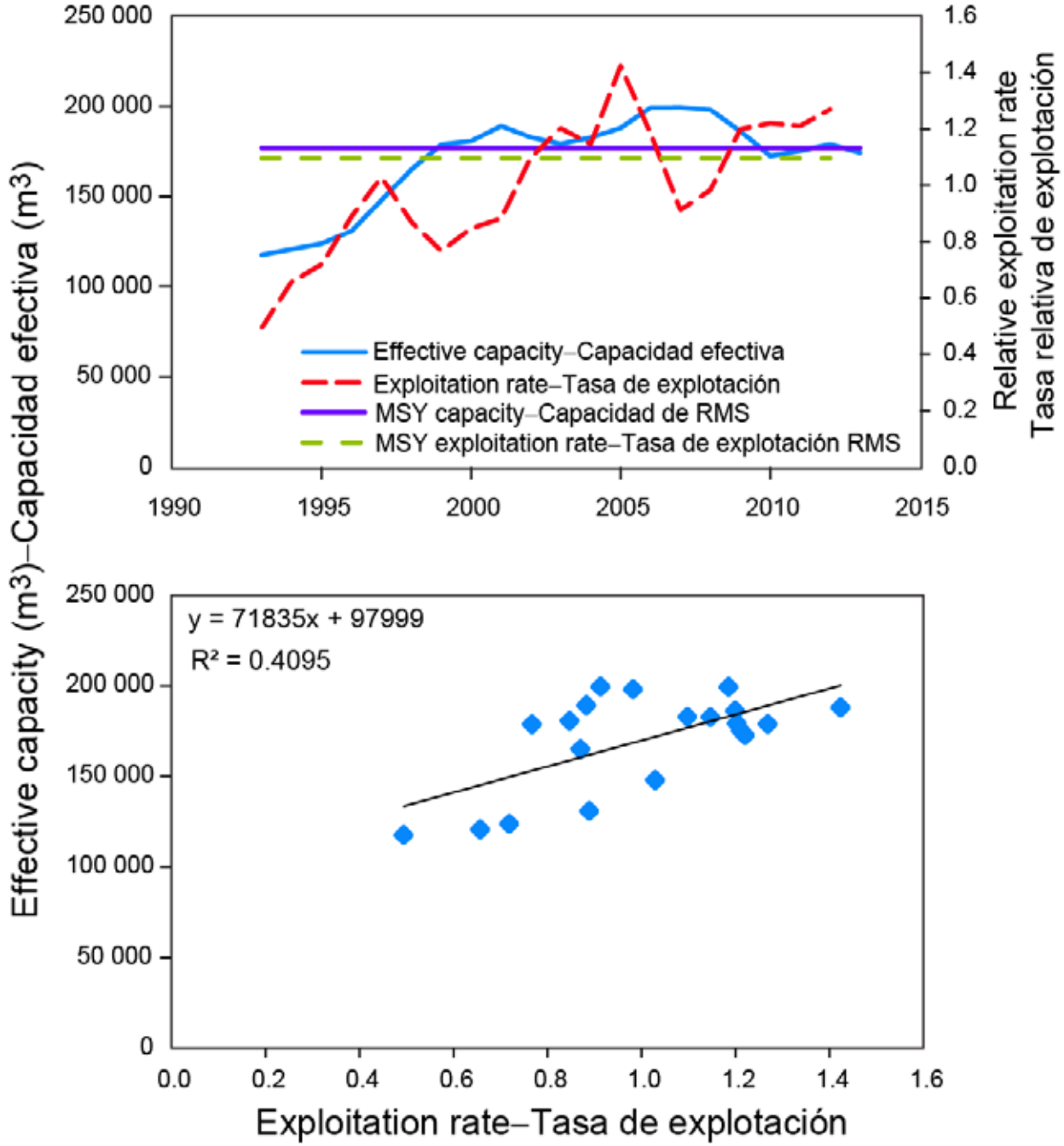

Effective capacity (m3)–Capacidad efectiva (m3)
Exploitation rate–Tasa de explotación
Effective capacity–Capacidad efectiva
Exploitation rate–Tasa de explotación
MSY capacity–Capacidad de RMS
MSY exploitation rate–Tasa de explotación RMS
y = - 8433.7x + 110241
R² = 0.0134
Exploitation rate–Tasa de explotación

Bigeye non-DML


Effective capacity–Capacidad efectiva
Exploitation rate–Tasa de explotación
MSY capacity–Capacidad de RMS
MSY exploitation rate–Tasa de explotación RMS
Effective capacity (m³)–Capacidad efectiva (m³)
Exploitation rate–Tasa de explotación
120 000
100 000
80 000
60 000
40 000
20 000
0
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1990
1995
2000
2005
2010
2015
y = 149849x + 9765.9
R² = 0.538
Exploitation rate–Tasa de explotación

Yellowfin and bigeye combined

- Catch weighted
- SKJ F = BET F


250 000
200 000
150 000
100 000
50 000
0
1990
1995
2000
2005
2010
2015
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Relative exploitation rate
Tasa relativa de explotación
Effective capacity–Capacidad efectiva
Exploitation rate–Tasa de explotación
MSY capacity–Capacidad de RMS
MSY exploitation rate–Tasa de explotación RMS
Effective capacity (m3)–Capacidad efectiva (m3)
y = 71835x + 97999
R² = 0.4095
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
Exploitation rate–Tasa de explotación